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PSYCHOLOGY AND HISTORY.[1]

BY PROFESSOR HUGO MÜNSTERBERG.
Harvard University.

A few years ago, at the Philadelphia meeting of our Association, the Presidential Address sketched the wonderful progress of our modern psychology and culminated in the statement: "We are past the time for systems of psychology; now handbooks of psychology are prepared." Psychology, indeed, since its declaration of independence, is eager to find out and to collect the special facts, without allowing the traditional interference of metaphysical philosophy, and that which brings us together in our Association ought to remain our common interest in the discovery of empirical psychical facts. And yet I cannot help thinking that many of us who sincerely agree with that enthusiasm for daily use are ready to confess the wish of thoughtful hours that, while handbooks of psychology appear now in masses, the time may come again for systems of psychology. We strive, I think, from the disconnected facts towards a systematic unity, and know that such unity is never reached by even the most complete collection of facts, but only by a philosophical understanding of the fundamental principles of our work. The discussion of the basal conceptions and categories of psychology, of its presuppositions and its limitations, of its relations to other empirical sciences and to philosophy, seems thus still more important and essential than the results of any observation, and the fact that in recent years inquiries in regard to the psychological standpoint

[1] President's Address, American Psychological Association, New York Meeting, December, 1898.

have come everywhere to the foreground of epistemological research appears to point more strongly towards the real progress of psychology than any discovery between the walls of our laboratories. I welcome, therefore, the more, the honorable opportunity of this hour, as I understand that the Presidential Address should emphasize the general problems of our science.

My address deals with the limits of psychology. I know quite well that such a choice easily suggests the suspicion of heresy; whoever asks eagerly for the limits of a science appears to the first glance in a hostile attitude towards it. To emphasize its limiting boundaries means to restrain its rights and to lessen its freedom. It seems, indeed, almost an anti-psychological undertaking for any one to say to this young science, which is so full of the spirit of enterprise: Keep within the bounds of your domain. But you remember the word of Kant: "It is not augmentation, but deformation of the sciences, if we efface their limits." Kant is speaking of logic, but at present his word seems to be for no field truer than for psychology. Psychology, it seems to me, encouraged by its quick triumphs over its old-fashioned metaphysical rival, to-day moves instinctively towards an expansionistic policy. A psychological imperialism which dictates laws to the whole world of inner experience seems often to be the goal. But sciences are not like the domiciles of nations; their limits cannot be changed by mere agreement. The presuppositions with which a science starts decide for all time as to the possibilities of its outer extension. The botanists may resolve to-morrow that from now on they will study the movements of the stars also; it is their private matter to choose whether they want to be botanists only or also astronomers, but they can never decide that astronomy shall become in future a part of botany, supposing that they do not claim the Milky Way as a big vegetable. Every extension beyond the sharp limits which are determined by the logical presuppositions can thus be only the triumph of confusion, and the ultimate arbitration, which is the function of epistemology, must always decide against it. It is thus love and devotion for psychology which demands that its energies be not wasted by the hopeless task of transgressions into other fields.

Philosophers and psychologists are mostly willing to acknowledge such a discriminative attitude when the relations between psychology and the normative sciences, ethics, logic, æsthetics, are in question. They know that a mere description and causal explanation of ethical, æsthetical and logical mental facts in spite of its legitimate relative value cannot in itself be substituted for the doctrines of obligation. The line of demarcation thus separates with entire logical sharpness the duties from the facts, the duties which have to be appreciated in their validity as ideals for the will, and the facts which have to be analyzed and explained in their physical or psychical existence as objects of perception. But can we overlook the symptoms of growing opposition against the undiscriminative treatment of the world of facts in the empirical sciences? The creed of those who believe in such uniformity is simple enough: the universe is made up of physical and psychical processes, and it is the purpose of science to discover their elements and their laws; we may differentiate and classify the sciences with regard to the different objects which we analyze or with regard to the different processes the laws of which we study, but there cannot exist in the world anything which does not find a suitable place in a system in which all special sciences are departments of physics or of psychology. In a period of naturalistic thinking like that of the Darwinistic age the intellectual conscience may be fascinated and hypnotized by the triumphs of such atomizing and law-seeking thought even to the point of forgetting all doubts and contradictions. But the pendulum of civilization begins to swing in the other direction. The mere decomposition of the world has not satisfied the deep demand for an inner understanding of the world; the discovery of the causal laws has not stilled the thirst for emotional values, and there has come a chill with the feeling that all the technical improvement which surrounds us is a luxury which does not make life either better or worthier of the struggle. The idealistic impulses have come to a new life everywhere in art and science and politics and society and religion; the historical and philosophical thinking has revived and rushes to the foreground. We begin to remember again what naturalism too easily forgets, that the interests of

life have not to do with causes and effects, but with purposes and means, that in life we feel ourselves as units and as free agents, bound by culture and not only by nature, factors in a system of history and not only atoms in a mechanism.

Such a general reaction demands its expression in the world of science too, and there cannot be any surprise if psychology has to stand the first attack. The naturalistic study of the physical facts may not be less antagonistic to such idealistic demands, and yet it is the decomposition of the psychical facts which oppresses us most immediately in our instinctive strife for the rights of the personality. The antithesis becomes thus most pointed in the conflict between psychology and history, and it seems to me that only two possibilities are open. One possibility is that these sciences stay yoked together, the one forcing the other to follow its path. Then, of course, two cases may happen. Either psychology remains as hitherto the stronger one; history must then follow the paths of psychological analysis and must be satisfied with sociological laws; every effort of history which goes beyond that is then unscientific, and the works of our great historians must seek shelter under the roof of art. Or—and this second case has all odds in favor of it—the belief in the unity of personality becomes stronger than the confidence in science, which merely decomposes, and psychology becomes subordinated to the historical view of man. That is possible under a hundred forms, but the final result must be always the same, the ruin of real psychology. I think this undermining of psychology with the tools of history is to-day in eager progress. Here belong, of course, all the most modern attempts to supplement the regular analyzing psychology by a pseudo-psychology which by principle considers the mental life as a unity and asks not about its constitution but about its meaning. Whether authors, half unconsciously, alternate with these two views from chapter to chapter, or whether they demand systematically that both kinds of psychology be acknowledged, makes no essential difference. Both forms are characteristic for a period of transition; both must lead in the end to giving up fully the analyzing view, to shifting the results of such analysis over to physiology, and thus to confining psychology

entirely to the anti-causal categories, that is to denying psychology altogether. Such turnings of the scientific spirit are slow, but if history and psychology remain chained up together the symptoms of the future are too clear: there is no hope for psychology.

But there is a second alternative open. The chain which forces psychology and history to move together may be broken, the one may be acknowledged as fully independent of the other. What appears as a conflict of contradictory statements may then become the mutual snpplementation of two partial truths, just as a body may appear very different from the geometrical, from the physical and from the chemical points of view while each one gives us truth. To those who have followed the recent development of epistemological discussion, especially in Germany, it is a well-known fact that this logical separation of history and psychology is, indeed, the demand of some of the best students of logic. They claim that the scientific interest in the facts can and must take two absolutely different directions: we are interested either in the single fact as such or in the laws under which it stands, and thus we have two groups of sciences which have nothing to do with each other, sciences which describe the isolated facts and sciences which seek their laws. A leading logician baptizes the first, therefore, idiographic sciences, the latter nomothetic sciences; idiographic is history; nomothetic are physics and psychology. Psychology gives general facts which are always true, but concerning which it has not to ask whether they are realized anywhere or at any time; history refers to the special single fact only, without any relation to general facts.

I consider this logical separation as a liberating deed, not only because it is the only way for psychology to escape its ruin through the interference of an historically thinking idealism, and also not only because the value and unity and freedom of the personality which history preaches can now be followed up without interference on the part of psychology, but because, independent of any practical results, it seems to me the necessary outcome of epistemological reflection. And yet the arguments which have led to this separation appear to me mistaken

and untenable in every respect. I agree heartily with the decision, but I absolutely reject the motives. No antithesis is possible between sciences which study the isolated facts and sciences which generalize; such a methodological difference does not exist. We shall see that it must be replaced by a difference of another kind, but the end must be the same: psychology and history must never come together again. To criticise the one way of attaining this end and to illuminate the other new way which I propose is the purpose of the following considerations.

We must proceed at first critically; what is the truth of the view which contrasts idiographic and nomothetic sciences? At the first glance the importance of the discrimination seems so evident that it appears hard to understand how it could ever have been overlooked. It seems a matter of course that the empirical sciences can ask either about the general facts of reality, the laws which are true always and everywhere and which do not say what happened on a special place and in a special time, and on the other hand about the single facts which are characterized just by their uniqueness. We may be interested in the physical and chemical laws of fire, but our interest in the one great fire which destroyed Moscow has an absolutely different logical source, and if we extend our historical interest from the physical to the psychical side, and investigate the stream of associations which passed during the days of that fire through the mind of Napoleon, we have again an absolutely different kind of interest from that of the psychologist who studies the laws of association and inhibition, which are true for every mortal. How small from a logical standpoint appears the difference between the search for physical laws and the search for psychological laws compared with the unbridgable chasm between the search for laws and the inquiry for special facts which happened once! And this difference grows if we consider that all our feelings and emotions refer to the special single object, not to any laws, that, above all, the personalities with which we come in contact come in question for us just in their singleness, and that we ourselves feel the value of our life and the meaning of our responsibility in the uniqueness of the acts by which we

mark our individual rôle in the history of mankind. These arguments of recent epistemological discussions will easily find the ear of the multitude. Common sense, which demands for itself the prerogative of being inconsistent, will probably hesitate only at the unavoidable postulate of this standpoint, that also the development of our solar system, of our earth, of our flora and fauna, belongs then to history and not to natural science, as they describe a process which happened once, and not a law.

I may begin my criticism at the periphery of the subject, moving slowly to the center. I claim first that all natural sciences, of which psychology is one, do not seek laws only but set forth also judgments about the existence of objects. Of course, we can make the arbitrary decision that we acknowledge the natural sciences as such only so far as they give eternal laws without reference to their realization in a special place or in a special time, while any judgment about the existence here or there, now or then, has to be housed under the roof of history. The sciences as they practically are would then be mixtures of historical and naturalistic statements, the historical factor diminishing the more, the more abstract the science, reaching its minimum in pure mechanics. Such decision has only recently found able defense, but do we not destroy, by its acceptance, the whole meaning of natural science? Are the laws for themselves alone still of any scientific interest at all? Why do we care at all for such general laws, as the law of causality, the most general of them, which embraces all the others, is included already in the presuppositions of science, and thus anticipated beforehand? When formal logic or mathematics deals with A and B and C, they state valid relations without asking whether A, B or C is given anywhere or at any time, even without excluding the possibility that their real existence may be impossible. The scientific judgments of physics and psychology, on the other hand, have lost all their meaning if we deprive them of the presupposition that objects which prove the validity of such laws have real existence in the world of experience.

We can construct well-founded physiological laws also for the organism of the centaur and psychological laws for the mind of nixes and water fairies, but both attempts do not be-

long within the system of science. The claim of existentiality is not explicitly expressed in the formulation of scientific knowledge, not because it is unessential, but because it is a matter of course. The larger the circle for which the law is valid the more we find these included judgments of reality deprived of their reference to special local and temporal data, but even in the most general propositions of mechanics such judgments are tacitly included. The question is not whether the objects with which the laws of mechanics deal have real existence from a philosophical point of view; certainly they have not. The important point is that mechanics by its laws tries at the same time to make us believe that even the atoms have existence. On the other hand, the existential judgment must become the more detailed the more special the law is, that is, the more complicated the conditions of its realization. If the psychologist states the laws of the feelings, he claims that it is not true that only men without feelings exist; he claims that men with feelings have reality too. If he gives us the more special laws of ethical feelings, he claims that experience knows men with ethical emotion. If he goes on with his specialization of the psychical laws, claiming that under special conditions the ethical emotion of obedience to the state comes to inhibit the desire for life, he tells us that this really happened. His psychological law becomes finally only still more detailed if he lays it down that under such and such conditions obedience to the state discharges itself in the drinking of a hemlock potion in spite of antagonistic suggestions of escape from philosophical friends. It is a psychological law and yet it claims at the same time that all this once at least really happened, while the complication of conditions practically excludes the possibility of its happening more than once in the world of our experience.

Of course, it remains a law of general character with regard to the absolute space and the absolute time; when all conditions including our solar system and all the events on the earth are given once more in infinity, then Socrates necessarily must drink once more the poisoned cup. But in the limited space and time of our experience the conditions for the realization of such a psychological law can have been given only once, and that

they really once were given is decidedly claimed and thus silently reported by the law. If our opponents maintain that the naturalistic sciences need as supplement a historical description of one special stage of the world to give a foothold for the working of the eternal laws, we can thus reject this external help for the explanation of the world, as the laws themselves furnish all that we need. The system of the laws is at the same time a full and graduated system of existential propositions with regard to the limited space and time of our experience. If ever and anywhere in the empirical universe a molecule had moved otherwise or another thought had passed through a consciousness, then the system of laws, thought in ideal perfection, would have demanded a change. Our physics and psychology presuppose and assert the real existence of exactly our world. They do not seek the laws with the intention of neglecting and ignoring the special facts.

The separation of the single facts from the general facts is thus untenable, because the explanatory law includes the description; but we can also emphasize the other side of this mutual relation: every description includes explanation, every assertion of a special fact demands reference to the general facts. A description has a logical value only if it points towards a law. We describe a process by the help of conceptions which are worked up from the general facts, common to a group of objects, and these general conceptions are the more valuable for the purposes of description the more their content is a condensed representation of real objective connections. The descriptions in popular language make use of conceptions which are deduced from superficial similarity, but every new insight into the physical and psychological laws gives to the general conceptions a more and more valuable shape. The history of science is the steady development of the means of description; there is no description which by its use of conceptions does not aim at working out the laws. Thus, far from the trivial belief that the law is merely a description of facts, we ought not to forget that the description of facts involves the laws and is only another form of their expression. To describe a physical thing as a group of atoms or an idea as a group of sensations demands the whole knowledge

of the psychological and mechanical laws and condenses in its conceptions the progress of science. To separate the descriptive report from the explaining apperception is thus again impossible.

It could appear that this does not hold for all kinds of description; we communicate with one another in practical life without relying on general conceptions. But our communication then is no description. Any mode of personal expression, gestures or tears, may tell us what is going on in the mind of another without reference to psychological laws. But the fact is that they give no description either; they give a suggestion. The words of practical life, the words of the poet and, as we may add at once, the words of the historian, work like such movements of expression; they make every mental vibration resound in us, because they force us unintentionally or with conscious art to follow the suggestion and to imitate the mental experience. The rhythm and the shade of the words may then be substituted for logical exactitude, and interjections may have deeper influence than complete judgments, but all that is decidedly no description, as a description demands a communication of the elements. Such a suggestion allows us an understanding of the meaning, but gives us no knowledge of the constitution. Where a single object really has to be described, there conceptions and laws are inevitable, and the historian cannot make an exception.

But just this fact, that description and explanation cannot be separated and that the conception includes the law, has opened in recent philosophical discussions a new way of thought which also seems to lead to those claims which we rejected. Granted, it is said, that every description presupposes generalizing abstractions, but such abstraction must then lead us away from the endless manifoldness of the reality. Every scientific description deals with physical or psychological abstractions; does that not mean that we need still another kind of treatment which does justice to the existing richness and fullness of the real single fact? If we give this mission to history we acknowledge that its communications would not be ordinary descriptions, but we should in any case again have the separated camps with the

antithesis: Manifoldness and abstraction, single fact and general fact. But the presupposition is wrong; the manifoldness of the reality is not endless and the abstracting conceptions are not at all unfit to do justice to the richness of the single fact. The single conception abstracts, but the connection of conceptions in the sentence reconstructs again. On the other hand, whatever is the possible object of perception and discrimination must be the possible object of descriptive determination. Whether the task of a complete conceptional description is difficult or not is no question of principle; impossible it is not. The ability to perceive differences is even inferior compared with the power to separate the differences conceptionally, and the abstracting description of science must, therefore, frequently increase and not decrease the manifoldness of the object. We know about the objects more than we perceive; above all, the description can never leave behind it a perceivable remainder which from its too great manifoldness excludes description. The full variety of the single facts thus belongs just as much as the most general law to the physical and psychological sciences; the antithesis psychology and history as coinciding with the antithesis abstraction and manifoldness of reality is then impossible. That history stands, indeed, nearer to reality than any psychology we shall later fully acknowledge, but, as we shall see, for very different reasons; history abstracts, we shall see, not less than psychology, and psychology is interested in the variety of the facts just as much as is history.

This brings us to our central arguments: Every science considers the single facts in their relations to other facts, works towards connection, towards generalities. Science means connection and nothing else, and history also aims at general facts, or it cannot hope for a place in the system of science. Does that mean that it is valueless to consider the single fact as it stands for itself, isolated and separated from everything else? Certainly not; the isolation is not less valuable than the connection, but it never forms a science; it is the task of art. The single fact belongs to art and not to history; history has to do with the general facts. That is the thesis which I must interpret and defend. One point, of course, is clear before the dis-

cussion. If we maintain that history has also to work up its material with respect to the general facts and not with regard to the single facts, then it is evident that there is in the deepest principle of the inquiry no methodological difference between physics and psychology on the one side and history on the other. But we insisted that an important difference does exist. The difference must then be not in the kind of treatment, but in the material itself. To be sure, there cannot be a physical or psychical object in the universe which would not be possible material for psychology or physics; if history deals with a material which is different from the possible objects of those empirical sciences, then it must deal with facts which differ from the physical and psychical objects in their kind of existence; in short, the difference between psychology and history is not a methodological but an ontological one.

We must then ask what kind of existence belongs to the material with which physics and psychology deal and how it is related to reality; above all, how far reality offers still another kind of facts which could be the substance of other sciences. Reality means to us here the immediate experience which we live through. This immediate truth of life may be transformed and remoulded in theories and sciences, and these remodelings of reality may be highly valuable for special purposes of life; we may even reach finally a point of reconstruction from which the subjective experience appears as an illusion and the supplementation stands as the only truth. Yet the importance of such constructions must not make us forget that we have then left reality behind us. Our doubting and remoulding itself belongs to the reality for which its products can never be substituted. And this primary reality can, of course, never be reached when we start from the finished theories of the physical or psychological sciences. Whether we pretend that the world is a content of our consciousness, a system of psychological ideas, or whether we start from the mechanical universe and consider experience as effect of the outer world on the consciousness, or whether we confuse the two and call the world a product of the brain, it is all equally misleading if we seek the reality, as each view presupposes equally the psy-

chological or physical constructions. It is then, of course, for us also impossible to reach the less remoulded primary experience by going backward through the genetic development of the individual or of the race to an earlier simpler stage of experience. Just this genetic tracing backward fully presupposes the categories of the psychological view; we must have already considered our own inner life as a complex combination of elements before it has a meaning to call the mental life of the child or of the animal less complex; the starting point of the genetic development is thus itself an artificial construction which lies further away from the primary experience.

If we thus escape all theories and stand firm against the suggestions which psychology and physics plentifully bring to us, then we find in the reality nothing of ideas or of mechanical substances, neither consciousness nor a connected universe. The reality we experience does not know the antithesis of psychical and physical objects, but in the primary stage merely the antithesis subject and object. We feel our personal reality in our subjective attitudes, in our will acts which we do not perceive but which we live through, and with the same immediacy we acknowledge other personalities as subjects of will. They too are not objects which we merely perceive, but we acknowledge them, by our feeling, as subjects with whom we agree or disagree and whose reality is thus not less certain than our own. Our acts as subjects are directed towards objects which in reality exist only as such objects of will, that is, as values. They are our ends and means, our tools and purposes, and nothing is to us real that is not called to be selected or rejected, to be favored or dismissed. Subjective acts of will and objects of will form the reality, the whole reality, nothing lies outside and nothing is valid beyond this world of will relations, and even if we form judgments about objects which we think as independent of the will, this judgment and this thought itself is an act of will working towards a purpose.

As soon as we begin to bring order into the manifoldness of this real world the subjective acts as well as the objects divide themselves into two groups, those of individual character and those which are common to all, over-individual. This division

means not a result of counting whether several subjects or by chance only one subject have made the decision or appreciated the object: it is a question of intention merely. My act is overindividual if it is willed with the meaning that it belongs to every subject which I acknowledge, and my object is overindividual in so far as I consider it as a possible object of attitude for every subject. My overindividual will-act is that factor of reality which we call duty; every duty lies in us as subjects, as our own deepest will, and yet as more than our individual decision. The overindividual objects are those which we call physical; the individual objects are the psychical ones; we must only not forget that these physical and psychical objects are in reality not in question as independent objects of perception, but are always related to the will; they are not contents of consciousness and mechanical bodies in a continuous space, but suggestions which have a meaning, things which have a use. We find thus four factors of reality, beyond whose validity a constructive metaphysics alone can go. Metaphysics may ask whether the individual and overindividual acts do not blend in an absolute subject and whether the objects are not posited by such a subject of higher order; epistemology must be satisfied with the more modest task of settling how we deal with this reality in our scientific or æsthetic knowledge. Reality itself is, of course, neither art nor science, but life. Art and science must be thus transformations of the material which life offers to us, while these transformations themselves are acts of the subjects and thus belonging to those will-formations which claim for themselves an overindividual character, creating the values of beauty and truth.

The acts which lead from life to art and science are thus for epistemology free acts of that subjectivity which we find in ourselves by immediate feeling, and which we acknowledge in others by an understanding of their propositions and suggestions; they are not functions of the psychophysical organism, not psychophysical processes, as we must have reached already the artificial reconstruction of science before the subject is replaced by that object among other objects, the psychophysical personality. Scientific and æsthetic acts are not the only functions of

the real subject; the ethical and others stand coördinated, but we are concerned here only with the two functions which do not aim to change and to improve the world but to rethink it in beautiful or truthful creations. It seems to me now that the two attitudes are in every respect antagonistic; to express their direction in a short formula, I should say science connects the factors of reality; art, on the other hand, isolates them. The material of science and of art is then the same, though treated by a different method. Both can deal with all the four factors of reality, with individual acts and overindividual acts, with individual objects and overindividual objects. Life does not isolate fully and gives no complete connection; whatever we turn to with our will has features which lead us further and further to ever new interests; life does not let us sink into the one alone —we rush beyond it to new realities. And life does not give connections beyond the immediate needs of practical purposes in the narrow circle of chance experience. Wherever is full isolation of single facts there is beauty, wherever truth there must be full connection.

The assertion that every isolated fact in its singleness means beauty has for us here only the character of a critical argument and is not for itself object of our discussion. It has for us merely the negative purpose of proving that the singleness cannot be characteristic of history. We cannot thus defend here this assertion by detailed discussion; we have only to elucidate its meaning. Certainly the real life, too, brings us pulses of experience in which our will is captivated by the given experience, satisfied with the object in itself or in the acknowledgment of other subjective acts; then we have the beauty of nature, the beauty of forms and of landscapes, of love and of friendship. Of course, it is only an exception when life offers to us in the untransformed reality such complete beauty; it remains the duty of art to change the world till everything is eliminated that leads the subject beyond the single experience, and the will can rest in the single fact. The world of objects is thus transformed in painting and sculpture, the world of subjective acts remoulded in poetry. The sentiment or the conflict which the poet suggests to us, the bust or the landscape which the artist brings before

our eye, is severed from the practical world; as long as anything connects it with the background of the daily world it may be useful or inspiring or instructive, but it is not beautiful. The poet projects his work into an ideal past; the painter cuts an ideal space out of the reality, and the sculptor fills an ideal space, not the space of our surrounding, to take care thus that the acts and objects may not link into our real world, may never become causes for outer effects, motives for actions, or centers for associations which lie beyond the frame.

We ought not to become skeptical in regard to this point on account of the overhasty generalizations in which empirical psychology mostly characterizes the æsthetic act as rich in associations. The epistemological problem we are discussing can not be settled by psychology, but as soon as the facts are expressed in the terms of psychological language they can not possibly assert the opposite of the epistemological truth. But there is no reason for such a conflict, as psychology is undoubtedly in the wrong. The psychological claim is based on the general theory that all pleasant mental states represent an increase of activity, and with it an increase of associations, while all unpleasant states are marked by a decrease of activity and lack of associations. I think that is wrong; there are different kinds of increase and different kinds of decrease in both ideas and actions. The antithesis pleasure and displeasure does not at all coincide with increase and decrease if we do not arbitrarily select such emotions as joy on the one and grief on the other side. Increase of activity characterizes pleasant and unpleasant states, only in the pleasant states it produces action of the extensors, in the unpleasant states action of the flexors. In the same way decreases of activity can have a double type; it can have its ground in the absence of stimulations, and this is, indeed, characteristic of some unpleasant states, but the lack of outer action can have its ground also in the fact that every motor impulse goes to the antagonistic muscles equally. This increase of tonicity without possible action is characteristic for one pleasant state above all, the æsthetic one. The increase and decrease of associations is here, as always, parallel with the motor impulses. Here also increase of associations is essential

for some pleasant states, but for some unpleasant ones too, only like the muscle activity, in antagonistic directions, in the one case turning to the future, in the other case falling back to the past. And the same doubleness is to be noted in the decrease of associations; in some unpleasant states the decrease comes from a mere lack of ideational impulses, in some pleasant states from the fascination which leads every ideational impulse again to the object itself, so that no thought can lead beyond it. This is again true, above all, for the æsthetic state. The beautiful object includes all that it suggests in itself, and where we connect we sin against the spirit of beauty.

By the contrast with art the fullest light falls on the process of science; every step towards science leads in the opposite direction. The incomplete connections of life are severed by art, but made complete by science, while the material is the same. We had four groups of facts in reality, and we must thus have four groups of sciences which bring systematic connections into the four different fields. We have the science of the over-individual objects, that is, physics; secondly, the science of the individual objects, that is, psychology; thirdly, the sciences of the over-individual will-acts, that is, the normative sciences; and, last, not least, the sciences of the individual will-acts, that is, the historical sciences. Physics and psychology have thus to do with objects; history and the normative systems, ethics, logic, æsthetics, deal with will-acts. Psychology and history have thus absolutely different material; the one can never deal with the substance of the other, and thus they are separated by a chasm, but their method is the same. Both connect their material; both consider the single experience under the point of view of the totality, working from the special facts towards the general facts, from the experience towards the system. And yet the difference of material must, in spite of the equality of the methodological process, produce absolutely different kinds of systems of science. We must consider again from the standpoint of real life how the connections of objects is different from the connection of attitudes, and how the purposes of the systematizing reconstruction are different in the two cases.

We and the other subjects have objects which are in reality,

as we have seen, objects of our will. Why have we an interest in considering the objects from a scientific standpoint, that is in systematized connection? If we do so, it must serve, of course, a special purpose in our real life. The purpose is clear. We cannot do the duties of our life, that is, we cannot act on the objects, if we do not know what to expect from them with regard to the reality which we prepare, and we call the reality which we can still prepare the future. We must ask, therefore, what we have to expect for the future from the objects alone, that is from the objects thought as if they were independent from the subjective will reaction. The answer to this question as to our justified expectations is the system of physical and psychological sciences. To reach this end we must think the objects, the individual or over-individual ones, as if they were no longer objects of a will, as if the subject were deprived of its real activity and were a merely passive perceiving subject the objects of which are thus definitely cut away from the will. Our interest was to determine their influence on the future. We thus consider every object as the cause of an expected effect, and call those characteristics of the object which determine our expectation of the effect its elements. Physics and psychology thus look on their objects as complexes of elements. It is the task of science to reconstruct and to transform the objects till each is thought as such a combination of elements that the effects to be expected can be fully determined from the elements. In this service grew up the atom doctrine in physics and the sensation doctrine in psychology. Each object is thus linked into a causal system; each is considered not as that which it really is, but as a complex of constructed factors which are substituted for the purpose of the causal connection, and each is in question in its relation to all the others. The world thus becomes a system of causally linked objects which can be described by their elements, while these elements themselves are chosen from the point of view of explanation by causality. The determination of the effects by means of the elementary causes is expressed by the laws which give the rules for our expectations. We can say thus that physics and psychology may very well consider any special facts, and, as we have seen, they certainly do not ignore the spe-

cial facts at all, but they consider them with regard to the causal law, and the laws as types of causal connections are thus the only general facts towards which the systematized study of objects can lead us.

Quite different is the systematic connection of the subjective will-attitudes; we may abstract here at first from the over-individual attitudes and concentrate our interest on the individual will-acts. In psychology the will-attitude as such, as act of the real subject, cannot have any place whatever; psychology deals with objects; the subjective attitude is never an object; it is never perceived; it is experienced by immediate feeling and must be understood and interpreted, but not described and explained. If psychology wishes to treat of the will, the psychophysical organism must be substituted for the real subject and thus the will be considered as a process in the world of objects. The description of any known will-acts as psychophysical functions, that is, as illustrations of psychological laws, thus as a matter of course belongs to psychology, and if the psychologist should analyze into psychophysical elements and explain as causally determined all will-acts and human functions of the last three thousand years, he would not transcend the limits of psychology. It would be a very useless psychological undertaking, but it would be such and not history. History starts from and deals with the real subjective will-acts which cannot be found in the world of psychophysical objects.

Our personal life in its political, economical, religious, scientific, æsthetic, technical and practical aspects is a manifoldness of will attitudes and acknowledgments. We live in the midst of a variety of political and social, technical and practical institutions, but no institution means anything else than expectations and demands which reach our will, and suggestions towards which we take attitudes. State and church, legal community and social set, what else are they but will attitudes which we acknowledge and which are, therefore, never understood in their real meaning if they are considered as describable objects, but which must be interpreted and appreciated as subjective will relations, striving towards purposes and ends. And to understand all the technical and practical institutions which civilization brings to

us means again not to describe or explain them, but to interpret them as will suggestions to be imitated. The machine and the book, the law and the poem, are not physical and psychical objects for our interests as living men, but suggestions and demands for the understanding of the intentions and attitudes of other subjects which we can enter into only by taking an imitating or rejecting attitude, thus reaching will by will. All our knowing and believing, our enjoying and respecting—as long as we abstract from their over-individual values—all our education and civilization, our politics and our professional work, is such a complex of real affirmations and negations, demands and inhibitions, agreements and disagreements, which have to be understood and felt and interpreted, but which are not touched in their reality if merely their psychophysical substitutions are analyzed and causally explained. To be a Chinese or Mohammedan, a symbolist or a Hegelian or an atomist, means to be the subject of special complexes of will attitudes and nothing else. If, for instance, we substitute the race for the state, then, of course, we have objects before us and no longer subjective attitudes, but then we deal with biological conceptions and no longer with history.

The manifoldness of will-acts the totality of which forms my real personality thus refers in every act to the will-acts and attitudes of other subjects which I acknowledge or oppose, imitate or overcome. These demands and suggestions of others are not in question in my life as causes or partial causes of my will; they have not to be sought in the interest of a causal connection; they are merely conditions which I as subject of attitude and acts presuppose for my free decision and which are thus logically contained in it; the connection is, therefore, not a causal, but merely a teleological one. The endless world of will-acts which stands thus in teleologically determining relation to our own will-attitudes forms the only material of history.

The material is, of course, unlimited. If every act of ours means an attitude towards acts of others which we must try to understand, it is clear that those others are understood only if their acts again are interpreted as attitudes towards the propositions and demands and suggestions of others, and so on and

on. Every will-act is thus ideally related to an unlimited manifoldness of other acts, just as the movement of every grain of sand is causally related to every molecule in the universe. It is the unique task of history as a science to work out and make complete this teleological system of individual will-relations, thus to bring out the connections between our acts and all the acts which we must acknowledge as somehow teleologically influencing our own. While physics and psychology thus produce a connected system of causes and effects, linking all objects which stand in connection with our objects, history follows up all the subjective acts which stand in will-relation to our subjective attitudes.

Physics and psychology, as we have seen, reach this end through striving towards laws and causality; that, of course, cannot be the way of history. The objects interested us only as factors which influence the future, and the laws by which we have connected them have satisfied this expectant interest. The subjects, on the other hand, do not interest us in first line as causes of effects. Of course, we are able to consider them also as objects which produce effects, and that aspect may become important to us in many practical respects; psychophysics will fully satisfy this kind of interest. And in the same way we may look on the development of peoples with an interest in what we have to expect from them; they are then sociological organisms, the laws of which we study; but such study is not history. The aim of the real historian is not to prophesy the future. Peoples never learn from history, and the forgotten doctrine that we ought to study history to find out what we have to expect from the future stands on the same level with its contemporary, the doctrine that it is the purpose of art to instruct us and to make us better. No, the historian makes us understand the system of will attitudes to which our individual will is related. That, indeed, alone, is our primary interest in the will-acts of other subjects; we want to understand them, not to analyze them into elements; we want to interpret their meanings and not to calculate their future. The objects awake our expectations; the subjects interest our appreciation, and all that we want to know about them is with what other attitudes they agree or disagree.

We thus have the logical aim, to consider them in their relations to all other will attitudes and to work out the system of these connections; that is, to consider the institutions which are the representatives of will suggestions, together with the personalities themselves, as links of this endless chain of will relations.

The purpose of history is not reached until every institution and personality with which we may be in a direct or indirect will relation is understood as a complex of agreements and disagreements, that is, of will attitudes towards other subjects. This regress must be, of course, infinite, just as no physical process can be reached which has not again causes and effects; and this task demands also, like the naturalistic sciences, a continual transformation. Just as the physical object is not really a complex of atoms and the psychological idea not really a complex of sensations, but must be in thought transformed into such to make causal connection possible, so in exactly the same way history must reconstruct the personalities and institutions as complexes of will attitudes, which they really are not, but as which they must be considered to make the unbroken teleological connection possible. And again, like physics and psychology, history too cannot communicate to us the whole of the connected system, but has to work out the general facts which give to every single fact at once its place in the whole system. These general facts in the teleological will system cannot be causal laws, but must be will relations of more and more comprehensive character. Just as in the world of objects the general law covers and determines the causal changes of an unlimited number of objects, so the important will-actions cover and determine in the world of subjects the impulses and suggestions for the decisions and attitudes of an unlimited number. The regularity of the causal law and the importance of the imposing will lift in a corresponding way the general fact over the level of the single facts. It is the work of history to make conspicuous the increasingly important will influences, as it is the work of physics and psychology to work out the laws. If I say I am a German, I want to assert by that statement that I acknowledge by my will a world of laws, institutions, hopes and ideals which are the will

demands of an undetermined multitude of subjects; this multitude constitutes the historical nation of Germany. But it would be unscientific if I should start to interpret the attitude of every one who is part of that chaotic mass of subjects; it is the work of science to find those influences which determined the multitude, those will-acts which were imitated and acknowledged by the unimportant subjects. The chaos thus becomes order, and Goethe and Beethoven, Kant and Hegel, Luther and Bismarck, stand as the general facts for the millions and millions of less important subjects who were determined by their suggestions. Any individual's historical place is then characterized by his will attitudes towards the leaders. Just as the naturalist knows a whole hierarchy of sciences which work out increasingly general laws up to mechanics as the most abstract system, so history can consider in different stages the will relations of more and more comprehensive character. The most abstract view is represented by the so-called philosophy of history, which aims at understanding the history of the world as determined by one decision of the will. In this spirit the conception of original sin in the theological systems of the Middle Ages was in the field of historical thinking perhaps not less marvelous than the conception of atomistic mechanism in the realm of natural science. The fact that Adam did not exist in reality is as little an objection to the mediæval construction as the fact that no atom can really exist militates against our atomism; both reconstructions of reality fill merely ideal places as necessary goals of thought.

On the other hand, in the same way that mechanics does not lower the importance of special natural sciences, no all-embracing theory of the history of man can interfere with the importance of the special historic disciplines down to the biographies of single personalities. But even the biography has to work in the same direction as the most abstract philosophy of history, in the direction of general connection. The real biography written in an historical spirit shows in the individual the attitudes towards the demands and suggestions which make the history of mankind; the single man becomes thus the crossing point of all the political, technical, religious, æsthetical, intellectual impulses of his time, and he is thus by the will-attitudes which

constitute his personality connected with the whole universe of will-acts. As the astronomer in his calculations describes the one curve of a star as the combination of a large number of impulses by attraction, and thus brings the star in relation to the whole firmament, so the historical biographer reconstructs the one life as a system of single attitudes towards an endless multitude of demands and suggestions. It is a complete transformation in the service of connection. The man's life can be told also otherwise: the life as he feels it as a personal experience; so also do we learn to understand the man; but we have then poetry and not history; it is isolation and not connection. And if we, instead, describe and explain his life as a set of ideas, feelings, emotions and volitions which arose in his psychophysical system from birth to death, then we have again a transformation in the service of connection, but this time for the causal connection of objects, not for the teleological connection of subjects; it is again not history, but psychology.

The separation of the material of the two sciences is thus simple and clear; there can never be a doubt about the line of demarcation, as there is no psychophysical object in the world—from the sensations of a frog up to the ideas of Newton, the emotions of Byron, and the volitions of Cromwell—which is not a suitable object of psychology, and as there is no subjective individual act which cannot be linked into the endless teleological system of history. A division of material, as if a social psychology, for instance, were to deal with the psychical processes of the unknown masses, while history were to deal with the psychical processes of the well-known men, is an absurdity. Not less misleading would be an antithesis between savagery and civilization. From a psychophysical standpoint such a line is secondary; the organism which has outer appendages of his body to make the psychophysical functions more effective has reached merely a higher stage of biological development, but is not different in principle from the lower type in which nature does not provide for detachable acquisitions of the organism. The animal which runs with locomotives, sees with microscopes, hears with telephones, makes gestures of expression through newspapers, attacks through cannons, remembers through libra-

ries, stands above the savage as a dog stands above a jelly-fish, but it is by principle nothing new; it is a more complicated product of nature which, therefore, offers a more difficult problem to the descriptions and explanations of psychology and physiology, but does not become as such material for history. And still another line of separation has to disappear; the fight between the 'materialists' and the 'idealists' of the recent economical schools has nothing to do with the doubleness of psychological naturalism and real historical aspect. If the materialists claim that every occurrence among men is the direct or indirect effect of economical causes, while the idealists consider other causes still which seem to them independent of material conditions, for instance, religious and patriotic emotion or ambition and love, both sides stand fully on the ground of psychology and outside of history. Those emotions of practical idealism are in question only as psychophysical causes and are thus material merely for a causal system. In the system of history exists no causality.

Here is the point where even the historians themselves are inclined to compromises which, at least in principle, must be rejected. Whether or not practically quite interesting reports of periods of civilization can be written by mixing the two attitudes is secondary. Historians, we know, produced in earlier times their deepest effects by mixing history with ethics, but the philosopher at least must be clear that ethics is not history, and he ought to be still less in doubt that a causally explaining social psychology is not history either. As soon as it is acknowledged that we have, on the one side, an interest to consider human life as an object and thus to describe and to explain it, and that we have, on the other side, a logical aim to understand human life as subjective acts which can be only interpreted and linked together by will attitudes, then we must have the energy to keep the two systems separated. Each is logically valuable, each is therefore true, but if confused both become logically useless.

We can say that Socrates remained in the prison because his knee muscles were contracted in a sitting position and not working to effect his escape, and that these muscle-processes took

place because certain psychophysical ideas, emotions and volitions, all composed of elementary sensations, occurred in his brain, and that they, again, were the effects of all the causes which sense stimulations and dispositions, associations and inhibitions, physiological and climatic influences, produced in that organism. And we can say, on the other hand, that Socrates remained in the prison because he decided to be obedient to the laws of Athens unto death. This obedience means, then, not a psychophysical process, but a will attitude which we must understand by feeling it and living through it, an attitude which we cannot analyze, but which we interpret and appreciate. The first is a psychological description; the second is a historical interpretation. Both are true. They are, to be sure, not equally valuable for science, as that particular psychophysical process is not more important for the understanding of the psychological system than millions of other emotions in unknown men, while that will attitude influenced by its demand the acknowledging will of twenty centuries, and is thus most important in the historical system. And yet both are equally true, while they blend into an absurdity if we say that those psychophysical states in the brain of Socrates were the objects which inspired the will of his pupils and were suggestive through two thousand years.

A history which interprets subjectively and understands their purposes out of the deeds of men relinquishes, indeed, its only aim if it coördinates these teleological relations with the causal explanation of human happenings from climatic and geographical, technical and economical, physiological and pathological influences. The subject which is determined by purposes is free; the action which is the effect of causes is unfree. In the unfree world there cannot be any action which must not be understood causally, and we have no right to stop anywhere in our explanation; the unexplained action means only an unsolved problem which is in no way solved if we seek for its subjective meaning instead of its elements and causes. In the world of freedom, on the other hand, it would be meaningless to ask for cause, as the objects then come in question merely as objects for the willing subjects and not as realities for themselves. The

realm of freedom is not made up of oases in the world of necessity; the reality of history is not spread here and there over the field of nature, but lies fully outside of its limits. The antithesis between psychology and history is thus not law and single event, but causality and freedom, and this difference is the logical result of the ontological difference of the material, the one dealing with objects, the other with subjects. Both go methodologically the same way, considering the single facts from the point of view of the general fact, and both transforming the disconnected material until a perfectly connected system is reached. But because objects are understood by describing and explaining them, while subjects are understood by interpreting and appreciating them, the connection of the one system must be causal, that of the other system teleological, and the general fact in the one field must be a law and in the other field the will relation of importance. As every subjective act can be substituted by a psychophysical function of an organism in the world of objects, and as every object can be understood as a value for a will, the whole reality can be brought without any possible remainder under the one aspect as well as under the other. History, in the real historical spirit, then need no longer fear that the progress of psychology can inhibit its functions, and the psychologist need not feel discouraged that his psychological laws of history appear so utterly trivial to the historian. That which is important for psychology, that which is fit for constructing connections between psychological objects, has the privilege of being indifferent for the historian, that is, of being unfit to link subjective will attitudes. Psychology and history cannot help each other and cannot interfere with each other as long as they consistently stick to their own aims. Each of them has thus unlimited opportunities for development. The processions of the great psychologists from Aristotle to Herbart, and that of the great historians from Thucydides to Macaulay, can both have for the future an unlimited number of followers without any quarrel, in spite of the naturalistic claims of our age, which for a while was under the illusion that all is understood when all is explained, and that the historians should better become psychologists.

As soon as the difference of the two standpoints is recognized, light falls on all the special characteristics of the two sciences. Now we understand why history stands so much nearer to real life than psychology. Not, as it was suggested, because history deals with single facts and psychology with general facts, but because psychology deals with objects which are thought as independent of the subject, while in reality and so in history the material is acknowledged only in relation to willing subjects. In real life we are subjects which must be understood but not described; psychology starts thus at once with a material which in its singleness is already farther away from reality than the material with which history deals. Now we understand also why the substance of history has value for us, while the objects of psychology and of all naturalistic sciences are emotionally indifferent. That is not, as it was suggested, because the single facts are important for us and the general facts indifferent; no, it is because the psychological objects, the contents of consciousness, are thought as cut loose from the will and thus no longer possible objects for appreciation, while the historical objects are thought as in their relation to the attitudes of the will. Now we understand also under which principle the historian selects his material. If we accept the view that all single facts belong to history as such, it is arbitrariness to chronicle Napoleon's battles and state acts but not his flirtations and breakfasts, while now we understand how it is that this selection means the most essential part of the historian's work, as it is the way to transform the reality into a system of teleological connections, thus dropping more and more the will-acts which have no teleological importance for will-attitudes of other subjects. Now we understand also why the language of the historian has so much similarity with that of the poet. The historian, we have seen, has aims which are directly antagonistic to those of the poet, as the poet isolates, while the historian, like every scientist, connects his material. But the materials themselves, the subjective acts, are common to the poet and the historian. Where the psychologist encourages the reader to take the attitude of the objectively perceiving observer, the poet and the historian speak of facts which can be understood only by interpreta-

tion and inner imitation; they cannot be described by enumerating their elements; they must be suggested and reach somehow the willing subject which enters into the subjective attitude of the other. Thus the means of both may approximate to each other. The poet and the historian may use the same methods of suggestion to reënforce in the reader the subjectifying attitude which is the presupposition for the understanding of the isolated will-acts in the work of poetry and the connected will-acts in the work of history, while the psychologist has to adapt even his style and his presentation to the service of his objectifying aim.

But we now understand and see in a new light also the relations of the psychological and historical sciences to the normative doctrines, to ethics, logic and æsthetics. As long as history appears merely as a part of psychology or as long as the one is given over to single facts, the other to laws, all the normative sciences stand without any inner relation to any empirical science, those speaking of duties, these of facts. For us the relation takes a very different form. We have seen that all the historical sciences are systems of individual will relations and nothing else. On the other hand, we have found that duty never means anything but our own over-individual will-act. All the normative sciences are thus the systematic connections of our over-individual will-attitudes, our will-attitudes aiming toward morality and truth and beauty and religion. As the over-individual will is, of course, thought as independent of the individual subject, the connection which is sought cannot lead as it did in history from subject to subject; as all subjects are presupposed as agreeing in their over-individual acknowledgment, the connection, the scientific aim can then lie here merely in the systematic connection of our own over-individual purposes and their interpretation. A transformation becomes here, too, necessary in the interest of connection; each single will attitude must be linked into this teleological system and must thus be transformed till it represents a crossing point of all the ethical, æsthetical, religious and logical impulses and demands. The normative sciences and history stand thus in the nearest relation to each other; both are transformations of will-acts in the service of teleolog-

ical connection, only the one reconstructs and systematizes the individual will-acts in us, the other the over-individual will-acts.

The relation between these two groups of sciences, the historical and the normative ones, is thus perfectly parallel to the relation between the psychological sciences and the physical sciences, of which the one systematizes the individual objects and the other the over-individual objects. The proportion—history—stands to the normative doctrines, as psychology stands to physics—is, indeed, true in every respect and in every consequence. We may consider here as our last word only one of them. The historical development of the naturalistic sciences shows the continuous tendency to take more and more of the properties of the physical object into the psychological object, that is, to show that the apparent over-individual qualities of the thing are qualities which depend upon the individual; color and sound, smell and taste, go over from the physical thing into the idea, and thus the whole manifoldness of our experience moves over into the sphere of ideas. In exactly the same way and led by the same methodological motives, history takes more and more of the normative duties over into its own field, and shows how the special duties, the logical beliefs, ethical convictions, æsthetical demands and religious postulates are the results of individual attitudes under the suggestion of the individual groups of will-influences. The absolute duties and beliefs and obligations and truths seem thus lost in our life as the colors and sounds and smells are lost for the physical objects. But the parallelism holds for the end-point of this development too. We must deprive the physical object of its colors and sounds, but we cannot give up the truth that there is a physical object nevertheless, as the quantitative reality to which we project, with objective truth, our sensations and ideas; all the naturalistic sciences would be destroyed if we were to give up this realistic conviction of physics. In the same way we may take into the individual all the single over-individual special duties of special nations and ages and social groups, but the reality of the background of projection we cannot give up. Whatever history teaches, the postulate of the reality of duties, of absolute values, stands firm. The abso-

lute duties may be abstract and deprived of color and sound as is the world of physics, but they stand and must last like the physical universe, and whoever in striving towards truth denies the reality of absolute values and gives up the belief in morality and the belief in logic, thus destroys and undermines his own endeavor to find the truth as logical thinker and to stand for the truth as ethical man.

A STUDY OF THE RELATIONS BETWEEN CERTAIN ORGANIC PROCESSES AND CONSCIOUSNESS.

BY PROFESSOR JAMES ROWLAND ANGELL AND HELEN BRADFORD THOMPSON.

I. Introductory.

Circulation and respiration are the organic processes with which this paper is mainly concerned. An inspection of the literature dealing with the relation of these processes to consciousness reveals a condition of disagreement among investigators, both as regards fact and theory. On the side of fact the discrepancies are gradually giving way before more accurate methods of observation and experiment. On the side of theory, however, the progress toward agreement is, perhaps, less noticeable.

The thesis which we shall defend in the following pages is based primarily upon experiments undertaken by us some two years ago with the purpose of determining whether changes in the character of attention were accompanied by any regular alterations in the organic processes above mentioned. The formulation we have reached should, however, if true, be equally applicable to the observations of other investigators. This we believe to be the case, although the description of these observations is often too meager on the psychological side to permit a satisfactory comparison with our own work. Within the bounds of its pretensions our formula, if correct, will have the value of a centralizing, harmonizing principle for a mass of facts which, from many points of view, appear self-contradictory and unintelligible.

At the risk of devoting a disproportionate part of our space to the matter, we shall begin by attempting a sketch of the more important of the relevant facts hitherto observed. So far

as we are aware, these have never been brought together in the form we adopt, and they furnish the best possible proof of the necessity for some general connective principle.

II. Historical Outline.

It will be convenient to state first the factors in the processes under consideration which have been thus far differentiated.[1]

The most striking alterations shown by the respiration consist in changes of rate and depth, or amplitude. The general type of the breathing also displays certain differences under varying conditions. Thus breathing in which costal or thoracic movements predominate may take on a more abdominal or diaphragmatic character. In addition to these changes, however, must be mentioned alterations in the general rhythm and in the duration of the various constituent factors in the total respiratory act. Thus the slight pause which follows expiration may be exaggerated or may practically disappear. Similarly the pause concluding inspiration may be altered in its relation to the total act.[2] Again, as accompaniments of such changes, we may find the usual relation between the phase of inspiration and that of expiration altered; the normal relation being that of a slight excess of expiration over inspiration.[3]

The more important aspects of the circulation, to which reference is made in this connection, may be summarized as follows: (1) The rate and force of the heart-beat. (2) The tension in the walls of the blood vessels—constriction or dilation. (3) The blood-pressure. (4) The amount of blood sent

[1] Excellent descriptions and illustrations of apparatus employed in such investigations will be found in 'La Fatigue Intellectuelle,' Binet and Henri, Paris, 1897. The technique of such apparatus has been carefully studied by Hürthle, Pflüger's Archiv, 53; also by Binet and Courtier, *L'Année Psychologique*, 1895. Cf. also Langendorf, *Physiologische Graphik*.

[2] Certain authorities question the genuineness of these pauses and regard the second as distinctly abnormal. Cf. Landois and Stirling, Physiology, p. 200.

[3] The amount of air breathed under various conditions, the amount of oxygen used and the amount of carbon dioxide exhaled have all been studied with much care, but we shall make no reference to these features, as the results attained do not appear to bear in any essentials upon the considerations with which we are here immediately concerned. See Speck, Physiologie des Menschlichen Athmens, Leipzig, 1892.

to the brain. (5) The amount of blood sent to the viscera.[1] (6) The amount sent to the periphery. (7) The interrelations between (4), (5) and (6). (8) The features of the cardiac, arterial or capillary pulse: its height or amplitude, shape, etc., with special reference to its anacrotic or catacrotic characteristics. It will of course be understood that in this analysis of salient features in the circulatory process, no implication of complete independence of the elements so distinguished is for an instant contemplated. As a matter of fact, some of the processes do at times vary irrespective of the action of others, but these interrelations will be canvassed more closely later on.[2]

We may summarize the results of the various investigations as follows: The dominant tendency of sensations of every kind is, according to the latest and most careful observations, to produce a vaso-constriction in the periphery and an afflux of blood to the brain. The amount and regularity of these alterations probably depend on the intensity and duration of the stimulus. Those investigators who find regular differences in the organic processes as accompaniments of the algedonic tone of the sensation, would necessarily make an exception in favor of such sensations as are distinctly agreeable and productive in their experiences of peripheral dilations. The effects of sensation upon the heart-beat, the form of the pulse curve and the respiration vary too widely with varying conditions to permit any generalized statement. But wherever a sensation breaks in upon a state of relative quiet and repose, so that a mild emotion or shock is produced, it generally produces acceleration of heart-beat and respiration, the latter being a trifle spasmodic and often deeper.

Mental activity of the type illustrated by application to mathematical computation, memorizing or recalling past experiences is, when contrasted with conditions of greater repose, accompanied by afflux of blood to the brain. Under the conditions of the ordinary laboratory experiment, such psychological pro-

[1] Points (5) and (7) concern processes too inadequately investigated to permit very definite formulations.

[2] As in the case of the respiration and for similar reasons, we make no reference to the observations upon the chemical changes attendant on alterations in these various phases of the circulation. Cf. Hermann's Handbuch der Physiologie.

cesses are sometimes productive of peripheral constrictions and sometimes show peripheral dilations. Their effects upon the form of the pulse curve are equally equivocal, but they result with greater regularity in increasing the rate of both heart-beat and respiration, the latter as a rule becoming more superficial.

Emotions of every sort seem more effective than other psychological processes in producing increase of blood in the brain. Vaso-constriction seems to be by far the most frequent volume change in the periphery, although a modification, similar to that mentioned under the head of sensation, has to be made in favor of those investigators who find opposite physiological expressions for agreeable and disagreeable experiences. The same restriction has to be placed on the statement that acceleration of heart and respiration and increased depth of the latter are accompaniments of all emotions. It is not possible at present to speak definitely of the changes in the form of the pulse curve.[1]

Without injustice to earlier investigators, it may be said that our serious knowledge of the connections between consciousness and the organic processes with which we are here concerned, begins with the classic and revolutionary observations, both clinical and experimental, of the great Italian physiologist, Angelo Mosso.

The results of his investigations may be briefly summarized as follows, bearing in mind that the psychological conditions involved are those of sensation, emotion and application to mental calculations. We may notice first the facts concerning changes in volume:

Psychic activity of every kind produces an increased flow of blood to the brain and a decreased flow to the periphery.[2] The changes which follow emotional excitements are much more marked than any produced by intellective processes, and the responses to emotional stimuli are more noticeable in the brain than in the periphery.[3] Sleep is accompanied by a withdrawal of blood from the brain.[4] Deep in-

[1] We shall occupy the remainder of this section with a more detailed statement of the investigations upon which this summary is based.

[2] Die Temperatur d. Gehirns, p. 109. Cf. also Patrizi, *Riv. musicale ital.*, 1896. Some interesting exceptions to this general rule have been observed. They consist of cases in which the activity of attention distinctly antedated the circulatory change. Cf. Die Ermüdung, p. 195.

[3] Kreislauf d. Blutes im Mensch. Gehirn, p. 72 ff.

[4] Kreislauf d. Blutes im Mensch. Gehirn, p. 74 ff. Stimulations which are so feeble to produce awakening nevertheless result in circulatory alterations of

spirations produce a decrease of blood in the brain, whereas deep expirations cause an increase. The same thing is noticed in the upper limbs, but in the lower limbs the relations are exactly reversed, a fact which apparently depends upon the inverse pressure relations of the thoracic and abdominal cavities, the walls of the one moving out as the walls of the other move in.[1] Superficial breathing produces practically no effect upon the cerebral circulation. The plethysmographic changes are not distributed simultaneously over the whole of the body. Local changes of both blood pressure and volume occur.[2] The changes in the volume of the brain generally precede the changes in the periphery and are, therefore, not to be regarded as on every occasion the mere consequences of such peripheral alterations.[3] The change in the brain is also often observed to outlast the change in the periphery. Moreover, the amount of such changes in the volume of blood in the brain is much less than the contemporary changes often occurring in the arm, for example, and of course much less, therefore, than those of both arms together.[4] Added to this is the fact that a decrease in the volume of a limb is not invariably accompanied by an equivalent increase of the brain volume.[5] The disparity is at times extreme.

Upon the much-mooted point as to whether or no the blood supply of the brain is controlled directly by mechanisms of its own, or indirectly through changes in pressure inaugurated elsewhere in the body, Mosso inclines to a positive opinion in favor of some neural process intrinsic to the brain itself, chiefly on the ground of the apparently primary and independent variations in the cerebral circulation.[6]

the brain and periphery. Several observers have confirmed these observations upon the effects of unconscious stimuli. Cf. Binet and Henri, ibid., p. 70; also Howell's Physiology of Sleep, *Jour. Experimental Med.*, 1897.

[1] Kreislauf d. Blutes, etc., p. 133. For following statements see pages 126 and 106. Cf. Marey, Circulation du Sang, for account of changes due to costal or abdominal forms of breathing.

[2] Cf. Bayliss and Starling, *Jour. of Physiology*, 1894, p. 159.

[3] Die Temperatur d. Gehirns, p. 152. Mosso's observations on changes in the blood pressure do not lend themselves readily to a generalized statement. The observations of other investigators to be mentioned later cover the ground more fully, and we therefore make no attempt to epitomize Mosso's work on this point.

[4] Mays questions the accuracy of these observations. He states, moreover, that he has only succeeded in obtaining noticeable alterations in cerebral circulation in response to emotions, other psychic processes being ineffective. Virchow's Archiv, 1882.

[5] Die Temperatur d. Gehirns, p. 147.

[6] The researches of Roy and Sherrington point to the direct effects, mechanical or chemical, of the metabolisms of the brain as sources, on some occa-

This is a convenient place to mention Mosso's striking view, confirmed in part by other observers, that the cerebral circulation is after all not the matter of primary import in determining the phenomena of psychic activities. It might naturally be expected that if mere increase of blood to the brain were the essential precondition of intense psychoses, any medium which would produce such increase of blood would be followed by increased mental activity. This is not always the case; witness the effects of amyl nitrite. The activity of the attention and of consciousness in general is rather to be connected with the functioning of certain nerves, which control those activities of the brain cells that are accompanied by psychic events. The appropriate analogy is that of the glands. Just as we find in these organs that mere afflux of blood is insufficient, aside from the action of certain nerves, to produce inception of their secretory functions, so the brain cells require blood for the exercise of their peculiar activities, but the mere presence of blood is not alone an adequate stimulus to such functioning.[1]

Turning now to Mosso's observations on the pulse and the heart-beat, we find the following general principles. With the exception of the rhythm and the height, or amplitude, the peculiarities of the pulse curve are entirely independent of the heart and find their explanation in the changing conditions of the various blood vessels concerned.[2] The relations between the energy and frequency of the heart-beat are not as yet definitely formulated. The heart-beat is ordinarily slower during sleep than at other times. The pulse becomes anacrotic (Fig. 1, A, after Mosso) after physical exercise, after heating the vessels and after the inception of complete physical and mental quiet; also as the result of hunger. On the other hand, intellectual activity is accompanied by a catacrotic pulse (Fig. 1, B), which is also the form observed after a meal. The anacrotic pulse is not peculiar to the

sions at least, of circulatory control. *Journal of Physiology*, XI., p. 85. Cf. also Wertheimer, *Archives de Physiologie*, 1893, p. 297. Gley has shown that in mental activity the flow of blood to the brain is, as Mosso thought, due to other causes than the heart. Étude expérimentale sur l'état du pouls, etc. Paris, 1881.

[1] Die Ermüdung, p. 195 ff. Moreover, it does not appear that the brain acts more promptly or more accurately (within the limits of ordinary non-pathological changes of volume) when it is flushed with blood. Patrizi has found the reaction time at the height of undulations in volume very slightly better than that at the lowest point of such oscillations. Cf. Patrizi, *Archiv d. Psichiatria*, 1896.

[2] Kreislauf d. Blutes, p. 49.

brain, but is found under certain conditions in other parts of the body.[1] The changes in the form of the brain pulse are noticeable only when vigorous mental activity is contrasted with complete rest. Intense intellective processes are accompanied by increased force of the heart-beat, probably because of the contraction of peripheral vessels necessitating a greater power to propel the blood through them.[2] Changes in the heart-beat are not always results of changes in the respiration, for they occur independently of such changes.[3]

Apart from the changes already mentioned in connection with the circulation, Mosso's statements about the respiratory accompaniments of psychic processes are somewhat unsatisfactory. In his book on fatigue he says, that observations upon himself show that revery is accompanied by faster breathing than voluntarily directed trains of thought.[4] When one does not attend closely, the diaphragm tends to become quiet and the thorax makes larger but irregular movements. In sleep the diaphragm is probably passive, but periodic changes occur under the effects of drowsiness. In an earlier work, however, he says it is impossible to make any satisfactory classification of breathing types as connected with mental activity, and some of his diagrams certainly conform but poorly to his formulation above quoted.[5]

M. Féré, in his treatise on sensation and movement, gives the first definite statement of antithetical physiological processes as the accompaniments of agreeable and disagreeable experiences respectively.[6] He differs from Mosso in finding certain sensory stimulations of emotional tone, which cause dilations of the peripheral vessels, instead of contractions. As is well known, he connects agreeable experiences of vari-

[1] These statements may be verified by reference to Kreislauf d. Blutes, etc., pp. 52–58, 114.

[2] Die Ermüdung, p. 184.

[3] Die Temperatur d. Gehirns, p. 150. There are, however, certain well-recognized changes in the heart-beat, as well as in the blood pressure and volume, which are due to respiration. The beats corresponding to inspiration are somewhat quicker than the others, and the amplitude of the pulse seems somewhat smaller. Binet and Henri (ibid., p. 50) have called attention to similar rhythmic changes occurring at intervals of three or four respiratory movements.

[4] Die Ermüdung, p. 182 ff. The description of the conditions under which these observations were made is too inadequate to permit satisfactory comparison with the work of other investigators.

[5] Cf. Kreislauf d. Blutes, etc., p. 70 ff. The irregularities in the breathing which he meets with in mental calculations are probably due to the distinctly abnormal conditions of his subjects.

[6] Sensation et Mouvement, Paris, 1887. He uses the words 'exciting' and 'depressing' instead of agreeable and disagreeable, but his meaning seems to be essentially as indicated.

ous kinds with such dilations of the peripheral blood vessels and with heightened tone of the voluntary muscles. Disagreeable experiences he finds accompanied by the opposite conditions of peripheral constriction and lowered muscular tone.[1] He finds momentary intellectual activity accompanied by momentary increase of power in the voluntary muscles.[2] His monograph is too inadequate in its statement of details to warrant critical comparison with the more complete investigations now at hand. It has distinct historical importance, however, because its statements, like those of the next author we shall mention, have been somewhat dogmatically incorporated in recent psychological treatises.

A. Lehmann, in his scholarly treatment of feeling, reports with much fullness his observations on the physiological accompaniments of agreeable and disagreeable experiences.[3] These agree essentially with those of Féré, but emphasize the following facts.[4] Pleasurable experiences are probably accompanied by increased amplitude of heart movements, disagreeable experiences by decreased amplitude of these movements and ordinarily by dilation of the deep-lying blood vessels. He also emphasizes more explicitly than Féré the deeper and more superficial phases of the breathing which he finds characterizing the two antitheses of feeling.[5]

Probably the most careful, systematic and important experiments, after those of Mosso, are those conducted by Binet in conjunction with Henri, Courtier and Vaschide. However much one may take issue with their usually conservative generalizations—and this is certainly the least convincing part of their work—one cannot abstain from the expression of admiration for the shrewd ingenuity and foresight with which they have executed their tasks.[6]

[1] Cf. ibid., p. 110 ff. and p. 7.

[2] The experiments of Patrizi (quoted by Binet et Henri, loc. cit., p. 194) showed that mental work carried on for an hour weakened the power of the voluntary muscles, unless there was some emotional excitement involved, in which case increased power was observed. In the last case, however, after a time the muscular strength fell below the normal.

[3] Hauptgesetze d. Mensch. Gefühlslebens, translated by Bendixen, Leipzig, 1892.

[4] Ibid., p. 82 ff.

[5] Lehmann's results, which were obtained by experiments upon five persons, certainly require confirmation. Like Féré's, they differ in the manner pointed out above from the results of Mosso, and they are distinctly at variance with many results obtained by recent investigators, not to mention our own.

[6] It will be convenient to refer in connection with these authors to a certain amount of the recent monograph literature, much of which is canvassed by them.

They find that vaso-constriction of the peripheral blood vessels is the usual result of psychic activity of any sort, especially when this follows relatively greater quiet.[1] There does not seem to be any constant and demonstrable relation between agreeable and disagreeable experiences on the psychic side and vaso-dilation and constriction on the physiological side. Pain has been observed to cause a dilation under certain peculiar conditions, and moderate pleasure has on several occasions been accompanied by constrictions.[2] The true psychic opposites from this point of view seem to be repose and activity with varying degrees of physiological excitation as their counterparts.[3] When attention is vigorously fixed on a calculation, for example, there is sometimes a dilation, whose nature is not known, and sometimes a constriction of greater or less duration.[4]

[1] This agrees with Mosso. See above.

[2] Binet et Courtier, *L'Année Psychologique*, 1897, p. 87 ff., also p. 126; Binet et Henri, ibid., p. 92.

Cf. also Patrizi, ibid. *Rivista di Freniatria*, etc., 1897. We know these articles only from reports.

Shields finds vaso-constriction of periphery with both agreeable and disagreeable odors—*Journal of Experimental Medicine*, 1896.

Dumas, *Revue Philosophique*, 1896, also 1897. Dumas' investigations with morbid and insane cases confirm in general the antithetical relations formulated by Lehmann and others regarding joy and sadness and the physiological expressions of dilation, constriction, etc.; adding some interesting observations on the changing number of blood corpuscles under these conditions. He meets curious exceptions, however.

Sewall and Sanford, studying changes of volume in the forearm under various forms of electrical, mechanical and thermal stimulation, found that strong stimulations generally produced constriction, whereas weak stimulations gave slight dilations after transitory constrictions—*Journal of Physiology*, XI., p. 179 ff.

[3] The very interesting experiments of Howell on sleep, already referred to, furnish beautiful supplements to Mosso's observations, and show that in normal sleep there is first a rapid decrease of blood in the brain, owing to fall in arterial pressure (chiefly in the periphery, it appears) with flooding of the peripheral vessels. This is followed by a period of relative quiet, and then the pressure gradually rises, the peripheral vessels undergo constriction and finally awakening occurs. He regards the fatigue of the vaso-motor mechanism as the immediate cause of sleep. He is inclined to disagree with Mosso concerning an independent vaso-motor mechanism of the brain.

[4] MacDougall, in his article on the Physical Characteristics of Attention (PSYCHOL. REVIEW, 3–158), practically agrees with the French observers, of whom we are writing, as regards the volume changes here referred to. Under the head of 'pulse and volume changes' appearing when attention is focussed on a continuous sensory stimulus, he omits any definite reference to the second part of his paragraph title, so we cannot record his results. With what he calls

Short, intense mental application—*e. g.*, the solution of a mathematical problem extending over three or four minutes—almost invariably increases the rate of the heart-beat.[1] After the cessation of the work, this acceleration may continue, or there may be a reaction toward a rate slower than the original one. The effects of long mental effort are less well known, but there seems to be an increased tendency toward slowing of the heart-beat, when compared with the natural tendency to retardation during the later hours of the day and in general under increasing fatigue.[2] Emotions of every kind, practically without exception, produce increase in the rate of the heart-beat. A few rare cases of pain and sadness have been observed to produce a gentle slowing of the rate. In general the changes observed, not only on the heart, but also on the other organic processes under consideration, show much more dependence upon the intensity of the emotion or affective condition than upon the quality as agreeable or disagreeable.[3]

'perceptual attention' he obtains first constrictions and then periodic fluctuations of dilations and constrictions. These undulations appear under several of the conditions he has studied, *e. g.*, attention to calculations, recalling of past experiences, and continued sense impressions.

[1] This has been noticed by a number of investigators, Cf. La Fatigue Intellectuelle, p. 41 ff. Mentz (*Phil. Studien*, XI., p. 567 ff.) reports a quickening of the pulse which seems closely related in its rate to the difficulty of the task undertaken.

Moderate physical exercise generally increases the rate and force of the heart-beat, but where excessive a contrary effect may be produced. The changes under physical exercise are, perhaps, due more immediately to alterations of blood pressure, which Marey has shown may by merely mechanical means affect the rate of the heart. In mental activity the pressure seems to rise, and as this alone should, on the grounds of merely mechanical explanations, decrease the rate, it is probable we have here a direct nervous control. Cf. La Fatigue Intell., p. 37 ff. and 58. Mentz finds (Cf. ibid., pp. 83, 95, 101) that auditory stimuli, whether noises or tones, produce at first slowing of the pulse and then a gradual quickening. Changes in intensity show the same result, the quickening beginning at the point where the stimulus becomes disagreeable. With involuntary attention acoustic stimuli were found to produce slowing, with voluntary attention quickening of the pulse. MacDougall (ibid., pp. 163, 169) obtained, with voluntary perceptual attention, increase of heart rate, with continuous sensory stimuli (tracing of figures on the face) slowing. The cases of retardation in the heart-beat reported by both these investigators seem to lend themselves with difficulty to harmonious incorporation in the observations and hypotheses of Binet and his fellow workers. They agree with our own observations, however.

[2] The capillary pulse may almost disappear under these conditions. It has been suggested that this is due to increased pressure. If true, this fact would seem to present a rather troublesome anomaly for Howell's interesting theory of sleep, elsewhere referred to. Cf. Binet et Henri, *loc. cit.*, p. 96 ff.

[3] Binet et Courtier, *L' Année Psychologique*, 1897, pp. 104, 125–126.

Mental work when intense shows a tendency to alter the form of the capillary pulse curve by decreasing its amplitude and with some persons rendering its angles blunter, while the dicrotic may move upward or shrink. With others there is instead of this a distinct emphasizing of the dicrotic and no noticeable decrease in angularity.[1] Conditions of quiet and repose are ordinarily accompanied by a pulse of large amplitude with clear dicrotic. It is possible that a classification of the emotions may prove to be feasible on the basis of the changes of the pulse, but this is hypothetical.

The blood pressure probably rises under every mental excitation, whether the occasion be attention to a sensation, to a calculation or to an emotion.[2] Nor does the nature of the emotion apparently affect the fact of this rise, although it may show a difference in the degree of the latter.

The rate of respiration is increased by mental work of every kind, both the expiration and the expiratory pause being shortened, emotions producing an increased amplitude in the respiratory curve, mental calculations and the like producing more superficial breathing, with decrease of amplitude in the curve. Occasionally sadness produces a slowing of respiration.[3] The effects of emotional states are, however, relatively irregular.

[1] Gley (ibid.) finds mental work increases the amplitude of the carotid pulse and accentuates the dicrotic. Binet et Henri (ibid.), p. 98 ff., also 113 and 120 ff. Binet et Courtier (ibid.), pp. 30–65. Physical exercise of a violent type seems to lessen the amplitude of the pulse and to diminish the clearness of the dicrotic.

[2] Kiesow's observation (*Philos. Studien*, 1895) that changes in blood pressure are noticeable only in connection with affective psychic conditions is criticised on the ground of inadequate technique.

[3] Binet et Henri, ibid., p. 156 ff. Binet et Courtier, ibid., p. 65.

Delabarre (*Revue Philosophique*, Vol. XXXIII., p. 639 ff.) found that persons who naturally breathe rapidly show relatively little effect on their respiration when their attention is engaged; but persons who ordinarily breathe slowly display a distinct tendency to acceleration of respiration when exercising their attention, the acceleration seeming to bear a general relation to the measure in which the attention is exercised.

MacDougall (ibid.) found that with perceptual and sensory attention there are generally increased rapidity and superficiality of respiration. The long inspiration and short expiration of sleep and relaxed inattention give way to lengthening of the time occupied by the second factor and shortening of the time of the first. The effects on the respiratory pause are ambiguous. Calculation produces the same general changes found by the French investigators. Recall of past events, when tinged with emotional excitation, is productive of great irregularity of amplitude and form, although the increase of rate is still observed.

Like ourselves, these investigators have been relatively less interested in the effects of psychological conditions upon the voluntary muscles. Mental activity certainly affects the muscles, but the effects differ, depending on the length of time devoted to the psychic process and on the presence or absence of an emotional tone in the experience.[1]

III. Theoretical Considerations.[2]

It will be observed that the investigations which we have been reviewing deal with two separate problems. The first problem concerns the differences in circulation, respiration and muscular tone which characterize the antithetical affective conditions denominated respectively agreeable and disagreeable. The second has to do with the differences manifested by these physiological activities under the various typical psychological conditions, *e. g.*, sensation, intellection, etc., and more especially with the differences distinguishing the affective from the non-affective processes. It is unnecessary to emphasize the lack of any established general principle of correlation for the results of these various investigations, much less to dwell upon the disagreements in regard to details.

Mentz (ibid.). In general the breathing tends to follow the rate of the pulse reported above. The strong tendency of heart and respiration to change rate together and in the same direction has been noticed repeatedly. The intimate nature of the connection is unknown.

Lehmann's interesting observations (*Philos. Studien*, Vol. IX., p. 66) on the fluctuations of attention and the different phases of respiration seem to show that the moment of completed inspiration, when the volume and pressure of the blood in the brain are at a maximum, is most favorable for mental activity. Needless to say, this does not altogether agree with Patrizi's observations.

Whipple has found (*Amer. Jour. of Psychology*, 1898, p. 560) that forced respiration seems to assist muscular activities, but to interfere with psychic processes and the functions of the higher centers.

[1] Jastrow (*Amer. Jour. of Fsychol.*, IV., 398; V., 223) and Tucker (*Amer. Journal of Psychol.*, VIII., 394) have studied the nature and direction of certain unconscious movements of the voluntary muscles connected with different psychological processes. Heinrich (*Zeits. für Psychol. und Physiol. d. Sinnesorgane*, IX., 342; XI., 410) and Mentz (ibid.) have found that with mental calculations the pupils dilate, the lenses become flat and the eyes assume nearly parallel axes.

[2] Logically and chronologically, Section IV. of the paper dealing with our own experiments should precede Section III, for the views defended here are based on the observations therein reported. The present order is adopted in the interests of brevity and clearness in presentation.

If we knew the precise significance in terms of organic metabolisms of such processes as constriction and dilation, we might hope to build up a theory on the basis of such knowledge. Unfortunately, this is not the case. Furthermore, we have seen that various observers have failed to note any uniform connection of these processes with pleasure and pain, in which conditions the 'vitality' theories would find the reflection of organic weal and woe. We find ourselves thrown back then upon some general view of the organism as a whole, if we desire a principle of interpretation for the phenomena concerned.

Such a view is offered us by the ordinary evolutionary doctrine, which finds the essential problem of the organism in the adapting of itself to an environment. This adaptation must involve on its physiological side metabolisms of various kinds, in which katabolisms and anabolisms must sustain certain fairly definite relations of dynamic equilibrium, provided the life process is to be subserved.

If we make reference to any one region or to any one process, the exact relations of these antithetic metabolisms must be constantly changing. Slight excesses of wastage at one point and one period will be offset by repair at a later period. The variations from equilibrium must in conditions of health be relatively insignificant, in order to permit of elastic response to the demands of the total environment. Moreover, these adaptive processes must be constantly in progress and must accompany the psychological conditions called intellective quite as truly as those called affective. Having regard, therefore, to the very various circumstances in which the organism is called upon to respond to changing stimulations, it seems at least possible that the regularity with which these metabolic processes progress, rather than the presence or absence of any one feature in the process, should be the most characteristic expression of the total organic condition. Certainly the presumption that a psychological process like pleasure in its multiform phases should, regardless of its concomitant mental conditions, be accompanied invariably by a single physiological process like dilation, implies a simplicity of structure and function in the psycho-physical organism and a constancy of organic and environmental conditions which probably do not exist.

In view of such considerations our experimental observations lead us to believe that the changes in circulation and respiration which accompany alterations of consciousness can be formulated in terms of attention as follows:

When the attentive process runs smoothly and uninterruptedly, these bodily activities progress with rhythmic regularity.[1] Relatively tense, strained attention is generally characterized by more vigorous bodily accompaniments than is low-level, gentle and relatively relaxed attention (of drowsiness, for instance); but both agree, so long as their progress is free and unimpeded, in relative regularity of bodily functions. Breaks, shocks and mal-coördinations of attention are accompanied by sudden, spasmodic changes and irregularities in bodily processes, the amount and violence of such changes being roughly proportional to the intensity of the experience.[2]

In order to make clear the application of this hypothesis to the facts at issue, we must analyze briefly the mental conditions concerned with reference to the attention. We shall need to consider the following: (1) Emotions of various kinds. (2) Sensations both feeble and intense, both expected and unexpected, both transitory and continuous, both agreeable and disagreeable. (3) Intellective processes involving memorizing, recalling and reasoning in the narrow sense, *e. g.*, mathematical calculations; also revery.

Now, emotions represent psychological conditions of great instability. Especially is this true when the emotion is profound. The necessity is suddenly thrown upon the organism of react-

[1] To prevent tedious repetition we shall hereafter, except when otherwise stated, use the phrases 'bodily activities,' 'bodily processes,' 'functions,' etc., to mean respiration and circulation.

[2] It will be remembered that the fundamental antithesis found by Binet and his co-workers is that of mental activity in general as against mental passivity. In apparently abandoning any one physiological change like vaso-constriction or increased rate of respiration as a criterion of the psychological condition, we do not mean to imply, even tacitly, that no single change of such character is an essentially constant companion of any one psychological process, like the emotion of anger, for instance. We simply emphasize the apparent absence of any such change as an invariable index of more than one or two conditions, whereas the changes as we formulate them appear to be constant for all conditions. The experimental portion of the paper will bring this point out more fully.

ing to a situation with which it is at the moment able to cope only imperfectly, if at all. The condition is one in which normal, uninterrupted, coördinated movements are for a time checked and thrown out of gear.[1] Equally spasmodic and interrupted is the activity of attention. It may on the other hand be asserted, in opposition to this view, that never is attention so monopolized and completely absorbed by a situation as in the case of a deep emotion. But this is to overlook the cataclysmic change at the outset of the emotion, as well as the violently recurrent rhythms with which the situation is surveyed.[2] In no strict sense does the attention ever delay long with absolutely one phase of an idea,[3] and by so much as the profound emotions are more intense than the ordinary experiences of life, by so much are the shifts in attention more violent than usual.

Moreover, affective conditions of every kind show their affinity with the emotions by a similar instability of attention. This instability is far less with agreeable experiences than with disagreeable ones. This may be connected with the fact, made much of by some psychologists, that pleasure represents a tendency to persist and pain a tendency to change.[4] It calls to mind also the theories of pleasure as associated with normal and moderate activities, and pain as associated with excessive activities.[5] But whenever the experiences are very intense we meet,

[1] Cf. Dewey, 'Theory of the Emotions,' PSYCHOLOGICAL REVIEW, Vols. I. and II.

[2] It may at first sight appear that, however fairly this description applies to the more tempestuous emotions, like anger, it is seriously defective when applied to some of the semi-morbid phases of grief and depression. Waiving the justice of the criticism of this characterization of the play of attention in the depressive emotions (we think the apparent difference of opinion rests on a confusion of attention to a topic of thought with attention to a single image), we may simply reiterate, that our observations indicate that the bodily changes run parallel, as regards their regularity or irregularity, with the mode in which attention proceeds. In general the emotions show a much disturbed condition in this particular. But for us this is more or less of an accident, and our contention would be in no wise affected if emotions showed a precisely contrary condition, provided attention also changed its characteristics.

[3] Cf. James, Prin. of Psy., Vol. I., p. 421. Ribot's Psychol. of Attention presents a thoroughgoing account of attention as 'monoideism.' The effects of neural fatigue would forbid any long-continued dwelling upon literally one idea. Cf. Hylan, 'Attention,' Monograph, PSYCHOL. REVIEW, 1897.

[4] Stephen, Science of Ethics. Horwicz, Psychol. Analysen.

[5] Spencer, Prin. of Psychology.

at the moment of their initiation at least, with relative instability of attention, though the continuance of this instability is incomparably more marked with the unpleasant states than with the pleasant ones.[1] This is tantamount, of course, to saying that the whole distinction is relative.

The different conditions of attention under which sensations may be experienced vary rather more widely than those of emotions, so that if we had regard only to the fact of the presence of a sensation, we might fallaciously assume a uniformity of conditions which does not exist. What we have said of affective conditions in general, in the previous paragraph, holds equally true when these affective experiences have a sensation as their basis, and need not be repeated here.

The distinction between expected and unexpected transitory sensations is one of considerable import for our interpretation.[2] This is the more true the more powerful the sensory stimulus employed. It becomes relatively insignificant as such stimuli approach the limen. The effect of an expected sensation upon attention will, if the sensation be not so intense as to produce shock, nor so feeble as to require excessive effort to detect it, be the securing of a slight strain of anticipation, with at times a somewhat definite relaxation when the sensation is felt. On the whole the play of attention is relatively free and unimpeded. When the stimulus is so faint as to require great concentration we may get more irregularities, owing to the fluctuations of attention from fatigue, distraction, etc. But still the conditions are relatively stable. With the very intense stimulus, whether expected or not, there is sure to be something approaching shock, and with this the introduction of a distinctly disagreeable affec-

[1] Ward's formulation of pleasure and pain in terms of the effectiveness of attention has much that is allied with the view we are presenting. It does not, however, seem to do full justice to the neutral-toned consciousness of moderate intellectual labor, where attention is apparently exercised with distinct effectiveness. (Cf. Ency. Brit., article 'Psychology.')

[2] The conditions involved in expected and unexpected sensations approximate closely those of voluntary and involuntary sensory attention (cf. Mentz, ibid.). The so-called cases of involuntary sensory attention are such as occur when a stimulus succeeds in breaking in upon a condition of mental pre-occupation, whether one be engaged in intense thought processes or in some of the various forms of revery. We cover both these cases, but do not use this terminology.

tive condition, whose consequences we have already canvassed. Indeed, a sensory stimulus of very moderate intensity may, if unexpected, produce this shock in a rudimentary way, and this more violent disturbance to attention is the principal difference noticed between the expected and the unexpected sensation. With many unexpected sensations this shock may practically disappear. The process going on at the time the stimulus is given will determine in large measure its effectiveness or ineffectiveness in producing such shock.

Sensations which are continuous, provided they be not very intense, produce conditions of attention which are relatively regular and stable. We speak here of the cases in which attention is intentionally fixed on the sensations. If continued long, we shall get rather definite fluctuations of attention, but these need not be violent within any ordinary limit of time. Sooner or later we should meet total collapse of attention, preceded by the phenomena of mal-coördination that accompany fatigue. Continuous sensations, which are not made definite objects of attention, produce very various results, sometimes being relatively ineffective and at other times seeming to modify materially the attentive process. The psychological conditions involved appear too ambiguous to warrant laying much stress on these cases.[1] A series of very intense sensations, or a really continuous sensation of this kind, will produce, as in the case of the transitory sensation, distinct shock and its disturbing consequences for attention.

From the standpoint of attention the intellective processes involved in memorizing and in simple mathematical calculations have much of affinity with the continuous sensation and represent relative stability and regularity. If the task becomes too confused, as it may when one is required to multiply mentally one three-place number by another, then we may meet with breaks and irregularities in attention. Moreover, we shall often find that such experiences are accompanied by a slight feeling of anxiety and distress, springing from the interest in accom-

[1] Cf. Mentz (ibid.). The chief difficulty in these instances arises from attempting to apportion the responsibility for the changes observed between the existing mental processes, into which the continuous sensation is supposed at times to inject itself, and the sensation itself.

plishing the work promptly and correctly. Where this element enters to any degree, we may look for the characteristics of emotion. Indeed, we may properly remark in this connection that under ordinary conditions these processes, which we are analyzing separately, necessarily overlap one another at times. The mental application in the case of the intellective processes is usually to problems received from sensory sources, visual, auditory, etc. The sensations impinge upon already existing affective and intellective conditions, and emotions are, with the best of intentions on the part of the experimenters and subjects, likely to intrude themselves in some measure upon all the processes studied. When the attention is relatively strained and tense, we meet the greatest stability and regularity, if the task in hand is just difficult enough to be successfully carried forward at the rate at which new aspects of it open up. Thus we may obtain great regularity of functioning, if series of problems in addition or multiplication are presented at just that rate which permits their most rapid solution, avoiding on the one hand unoccupied leisure between the problems, and on the other hand insufficient time for completing them.

The cases in which one attempts to recall past events show considerable variations, depending on the nature of the subject-matter recalled. Verbal material which has been learned by heart may be recalled under conditions of great stability and regularity of attention. Events, on the other hand, may or may not be recalled readily, and if they do not come to mind easily we shall get more or less instability of attention, the results depending on the amount of effort put forth. Such processes are especially prone to take on emotional coloring with its tendency to instability.

Revery, in the proper sense of the word, represents frequently a high degree of free and regular play of attention, interrupted now and then by the emotional suggestiveness of the subject of thought. When revery passes over into drowsiness, the attention becomes much relaxed and functions on a low level of intensity, but yet as a rule with a considerable degree of smoothness. Individuals vary vastly, however, in the nature of the revery process.

If we turn now and arrange our psychological conditions in a hierarchy representing increasing stability of attention, we shall obtain something of this kind: (1) The profound emotions, presenting sometimes an appearance of stability, but even here distinctly of the abnormal, paralytic type. (2) The more violent affective conditions, certainly the disagreeable and painful experiences, less confidently the instances of extremely pleasurable experiences. (As has often been mentioned, it is exceedingly difficult to produce very intense pleasures under laboratory conditions.) (3) Cases of transitory and relatively superficial emotions (including cases in which emotional excitement occurs, although the conditions are ostensibly those of intellective processes, *e. g.*, recall of past events) intermingled with responses to unexpected sensory stimuli of moderate intensity and brief duration. Expected sensations, if relatively intense, also belong in this class, together with many agreeable sensory experiences. (4) Cases of continuous sensations, the regularity being greater in proportion to the effort made to attend and being, perhaps, greatest with relatively weak sensations. Mental application, as in the case of mathematical calculations, when executed under the most favorable conditions as above described. Many cases of non-emotional revery. The revery of drowsiness differs in its type of regularity from that manifested by application to a problem, in that one is accompanied by the phenomena of relaxation and the other by those of greater organic excitation. But both are relatively stable.[1]

This brings us to a consideration of our experimental material. After a brief description of the conditions under which we have worked, apparatus, etc., we shall proceed to show how radically the physiological accompaniments of apparently similar psychological conditions may vary from time to time, depending on the manner in which attention functions. It should

[1] It will be understood that this classification pretends to nothing but a rough suggestiveness of the relations these different processes bear to one another when attention is employed in this way for connecting them. It will have served its purpose if it brings out a few salient relationships, such, for example, as the community of certain sensation processes with intellective conditions and that of certain other sensation processes with emotion.

not be understood that we dogmatically deny any constancy of changes aside from the form of constancy we emphasize, although such constant conditions are rare. We simply maintain that from our observations the only feature which appears essentially constant under ALL PSYCHOLOGICAL conditions is the relative stability and instability (of the dynamic type) which these organic activities manifest in connection with the different processes of attention. We have stated this previously, but repeat it to avoid confusion and misunderstanding.

IV. Report of Experiments.

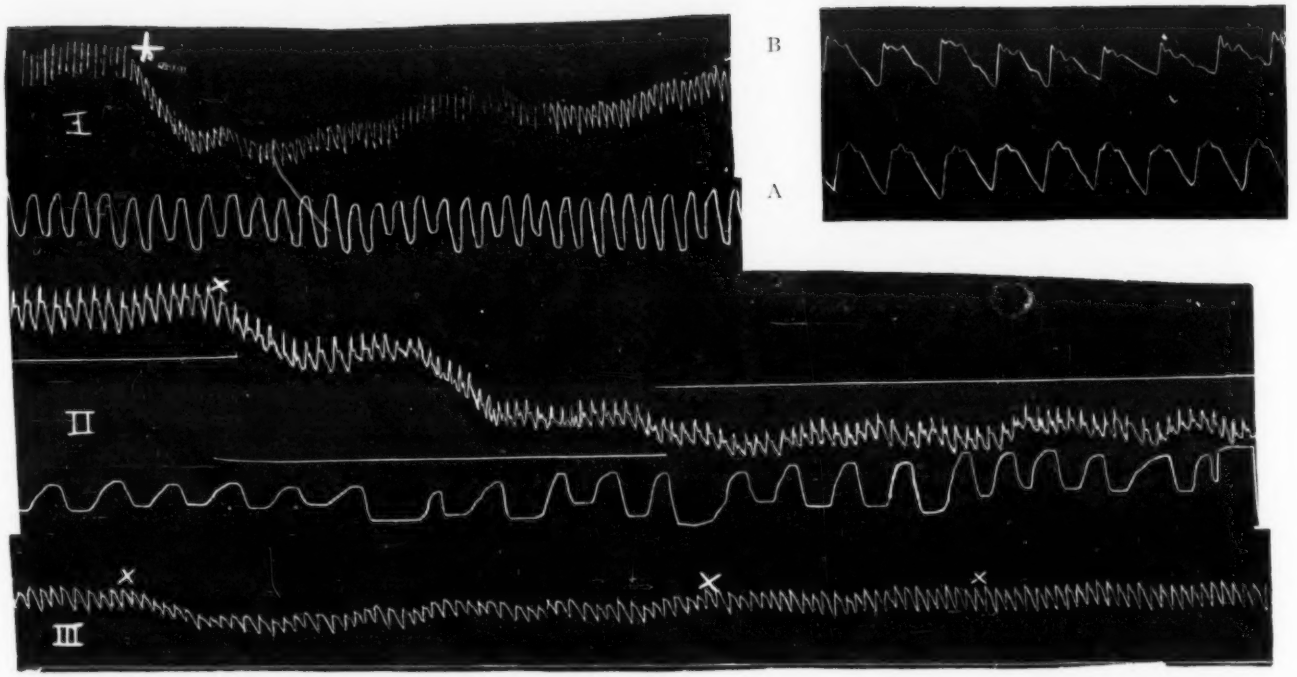
The experiments which give rise to this paper consist of two very complete series of tests taken from two different subjects. Less extended observations upon a number of other subjects have tended to confirm our confidence in the general position we adopt.

The curves showing circulatory changes are all capillary pulse tracings, taken with the air plethysmograph invented by Hallion and Comte. The air plethysmograph was adopted in preference to the water plethysmograph, cardiograph, or any of the methods of taking the arterial pulse directly, because of the greater delicacy and accuracy with which it registers slight variations in the form and amplitude of the pulse curve. The plethysmograph was connected with a Marey tambour, writing in the ordinary manner upon a smoked drum. After a somewhat extended series of experiments upon technique, the most advantageous bodily position, adjustment of the plethysmograph, quality of rubber and length of pointer for the tambour and relative position of tambour and drum were adopted and preserved throughout the experiments.[1] Careful tests upon the accuracy of the instruments have convinced us that the curves may be relied upon for recording the direction of changes in the volume of the blood in the hand, in the rate of the heart-beat, and in the form and amplitude of the capillary pulse.[2]

[1] The conditions adopted by us agree substantially with those of Binet and his co-workers. The fact that a few of our curves are to be read in a different direction from the others arises from a temporary reversal of the drum, which has no effect whatever on the curves, although we regret the lack of uniformity in their appearance.

[2] The apparatus does not record pressure changes.

PLATE I.



I., Anger; II., Emotional Excitement; III., Cross 1, Embarrassment; 2, Addition; 3, Multiplication.

EXPLANATION OF CUTS.

1. All curves read from left to right, except when arrows indicate the contrary. 2. The process illustrated by the curves begins in every case at the point indicated by a cross. 3. A fall in the pulse curve always indicates vaso-constriction, and a rise vaso-dilation. 4. The respiratory curves, when given, are always placed immediately under the pulse curves with which they belong.

The absolute measurements of the curves of one day could not, however, be compared with those of another, since slight changes in the adjustment of the plethysmograph or of the tambour produce slight alterations in the absolute dimensions of the curves.[1] A modified form of Bert's respirator was used for recording the breathing curves.

The emotional experiences of this series of experiments were spontaneous emotions arising from the subject's own thoughts when left to himself. The most noticeable effects of emotional states upon the bodily processes are the sudden, violent changes and irregularities produced. The vaso-motor shifts are the most evident of these changes, although marked irregularities in the rate and amplitude of both breathing and pulse curves occur. In Plate I., Figs. I. and II. show characteristic cases of violent emotion; Fig. III. is an example of one of the milder emotions, embarrassment.

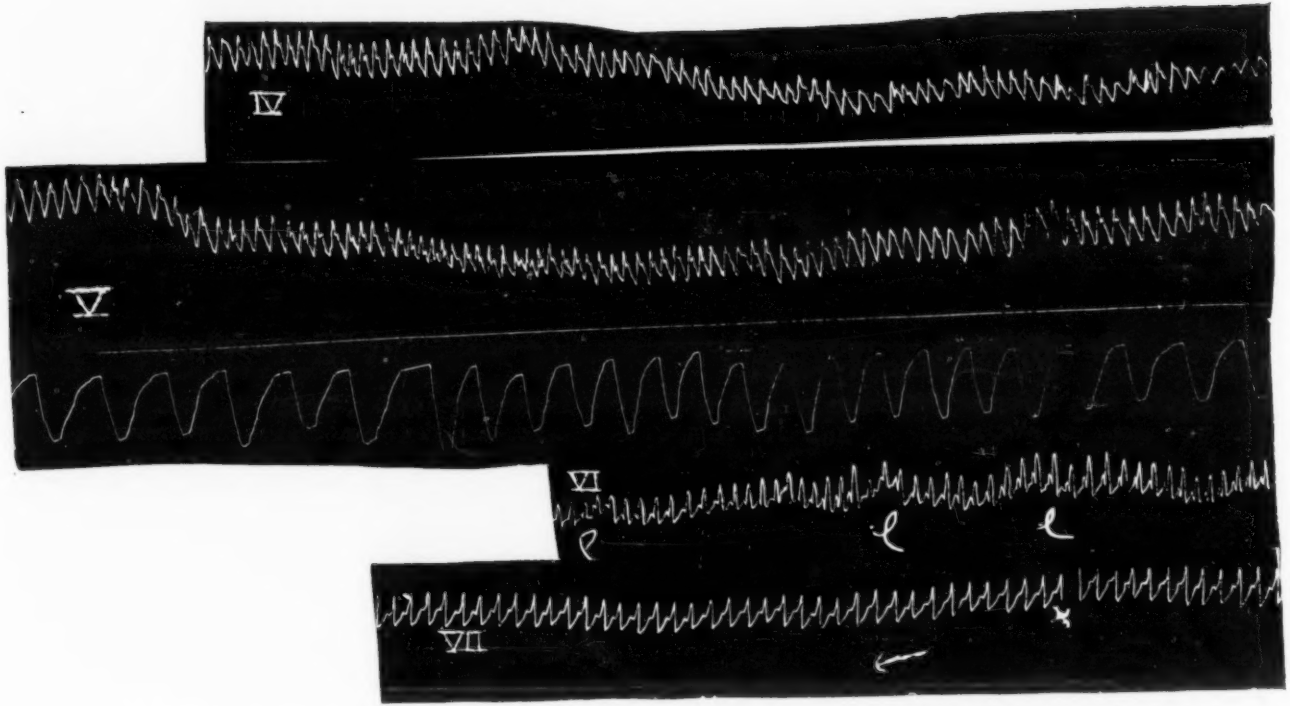
It is in the case of the emotions, where the agreeable and disagreeable experiences are most intense, that we should expect to find the most marked and constant correspondence of agreeable states with one set of physiological processes and of disagreeable states with an antithetical set, if any such relationship existed. But our curves show not the slightest evidence of such an interconnection. None of the various factors involved, vaso-motor level, rate and amplitude of the pulse curve, position and emphasis of the dicrotic notch, or rate and amplitude of the breathing, changes uniformly in one direction for agreeable experiences, and in the opposite direction for disagreeable experiences. No doubt cases occasionally occur where some regular connection of the kind mentioned is found. But it is occasional and not invariable, in fact probably rare. Almost all of our emotional experiences, whether agreeable or disagreeable, produced vaso-constrictions. This agrees with the observations at the Sorbonne and is what Mosso's work would lead us to expect. Figs. IV. and V. (Plate II.) are examples of an unpleasant and a pleasant anticipation respectively, experienced

[1] Binet expresses a greater confidence in the comparability of curves taken at different sittings than our experience has led us to feel. But, as the matter is largely one of skill, he is doubtless justified in his assurance.

EXPLANATION OF CUTS.

1. All curves read from left to right, except when arrows indicate the contrary. 2. The process illustrated by the curves begins in every case at the point indicated by a cross. 3. A fall in the pulse curve always indicates vaso-constriction, and a rise vaso-dilatation. 4. The respiratory curves, where shown, are always placed immediately under the pulse curves with which they belong.

PLATE II.



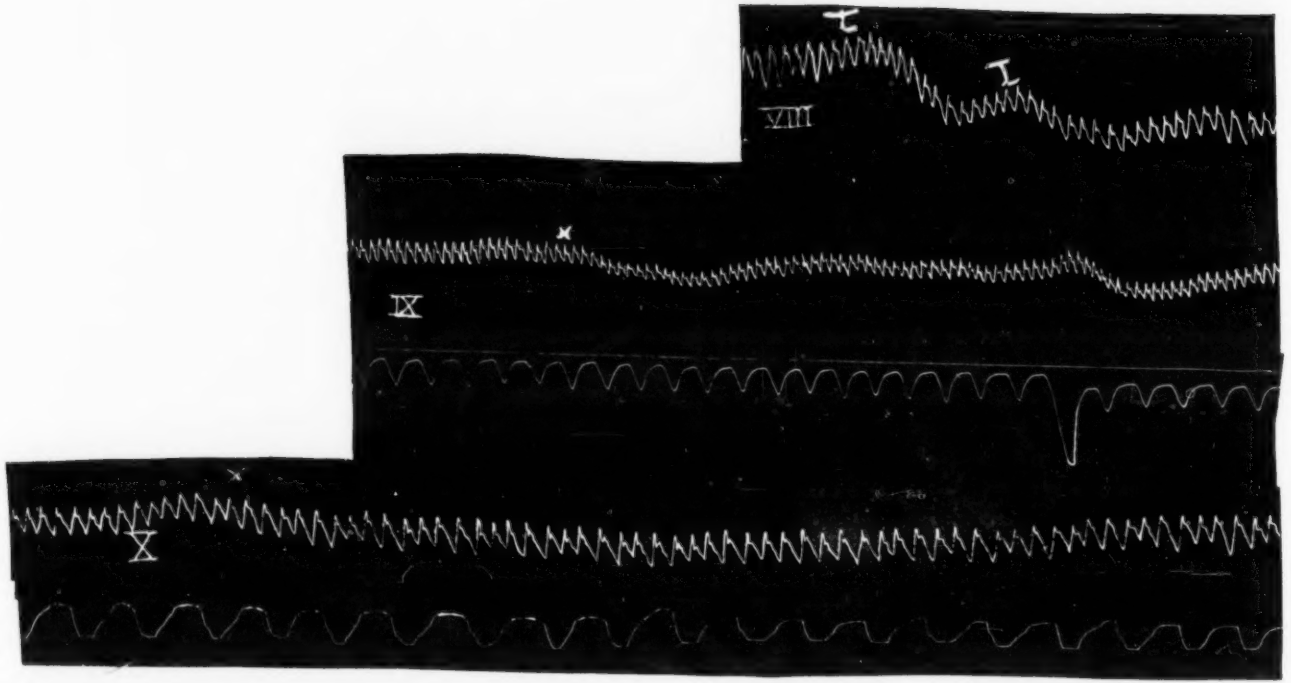
IV., Unpleasant Anticipation; V., Pleasant Anticipation; VI., Laughter at each point marked 'L;' VII., Amusement.

by the same subject at one sitting. Both cause violent vaso-constrictions. The most important exception to this rule is the fact that with one of the subjects, laughter causes a slight, sudden vaso-dilation (see Fig. VI., Plate II.).

At first sight the vaso-dilations due to laughter would seem to be a confirmation of the theory that agreeable experiences are accompanied by dilations of the peripheral blood vessels. But there are several facts which take away the value of this evidence. In the first place, the vaso-motor change seems to be a secondary effect of the sudden spasmodic change in the breathing. Of course, the spasmodic breathing of laughter is an essential factor in it, and it is impossible to separate the secondary vaso-motor changes due to breathing from those accompanying the feeling of amusement in laughter. But the character of the vaso-dilations seems to run parallel with the breathing changes rather than with the feeling of amusement, which does not, as every one knows, always correspond with the heartiness of the laughter. A hearty laugh, causing sudden, violent changes in the breathing curve, is accompanied by the sharpest and most marked vaso-dilation, while a smile or mild laughter causes much slighter and more gentle changes in the vaso-motor curve. In confirmation of this view, we have one curve from this same subject, in which mere feeling of amusement, unaccompanied by any of the breathing changes of laughter, produced a slow vaso-constriction (VII., Plate II.). But more important still, as contrary evidence, is the fact that, in the case of the other subject, constriction and not dilation is the most marked vaso-motor accompaniment of laughter. VIII., Plate III., shows characteristic laughter curves for this subject. They display slight initial dilations followed by marked constrictions. In this case, too, the amount of the vaso-motor change is in general proportional to the amount of the disturbance in the breathing. But why in one subject spasmodic breathing should have vaso-dilation as its concomitant, and in another subject vaso-constriction, is a mystery. However, the facts show that the dilations of laughter in this case can not be taken as confirming the theory that vaso-dilation accompanies pleasant experiences.

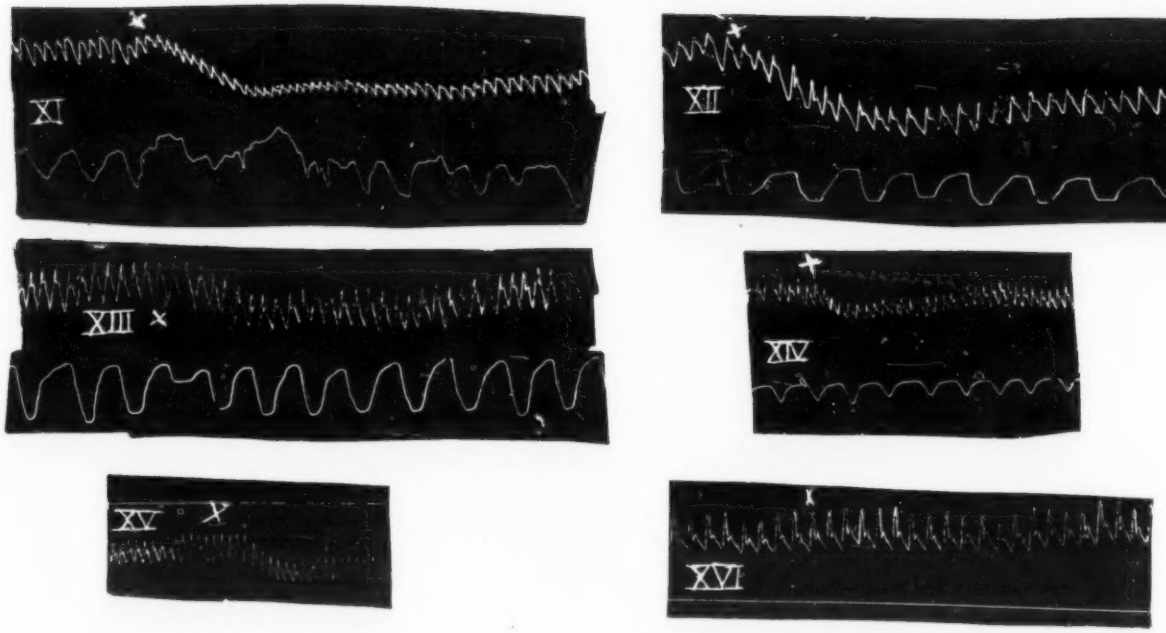
The amplitude of the pulse curve shows a greater or less

PLATE III.



VIII., Laughter marked 'L'; IX., Interest followed by Emotional Excitement at Cross; X., Apprehension, warned of impending shock.

PLATE IV.

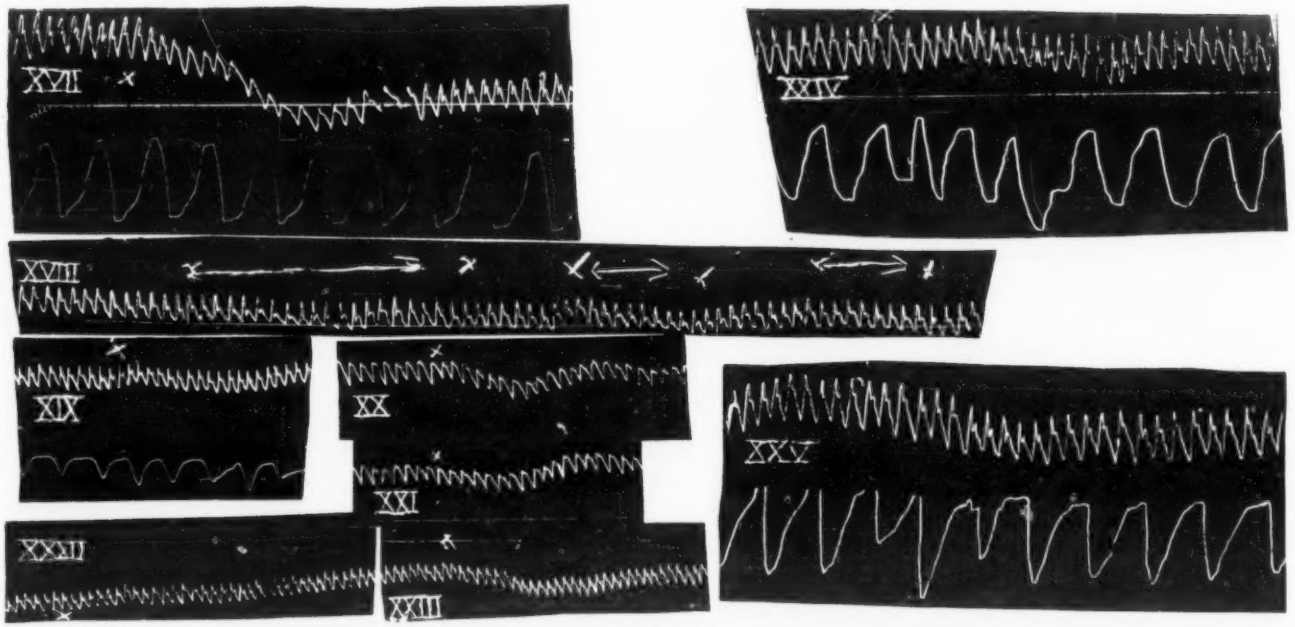


XI., Cold; XII., Noise; XIII., Camphor; XIV., Cold; XV., Noise; XVI., Camphor.

decrease for both subjects in almost all of the emotional experiences, whether agreeable or disagreeable. There were, however, a few cases of increase of amplitude. The great irregularity of amplitude during emotional experiences is a more uniform factor. (See Figs. I., II., III. and IX.) The rate of the heart-beat is sometimes increased *on an average*, sometimes decreased, and sometimes not changed at all. Increase of rate is much the most frequent occurrence regardless of the quality of the emotion, but all of these changes take place during each of the two great emotional states (compare Figs. I., rate unchanged; II., rate increased; III, rate both increased and decreased; and X., rate decreased). But whatever the average change of rate may be, a more uniform and, in our opinion, more significant feature is the spasmodic irregularities of the rate characteristic of curves corresponding to emotional states (compare Figs. I., II., III., IV., V. and X.), a feature strongly indicative of the general physiological instability of emotional states for which we are contending. The changes in form and position of the dicrotic notch[1] are as erratic as the amplitude and rate changes. The notch is sometimes raised, sometimes lowered, sometimes emphasized and sometimes flattened, with entire disregard to the affective tone of the emotion.

The breathing during emotional experiences shows no greater uniformity in direction of change than the pulse. All the variations of increase and decrease of both rate and amplitude of the breathing are found accompanying both agreeable and disagreeable experiences. In the more violent emotions (see Figs. I. and II.), and, of course, in laughter, the breathing becomes very spasmodic and irregular as to both rate and amplitude. The lesser emotions show smaller disturbances (see Figs. IV., and X.), while some of them show no change at all (see Fig.

[1] The emphasis and position of the dicrotic notch vary greatly in our different curves. This is no doubt largely due to the fact that the dicrotic notch varies so greatly at different times of the day and under different conditions of nutrition and of activity. (See Binet and Courtier, *L'Année Psychologique*, 1897, p. 10.) It may also be due in part to slight differences in the adjustment of the instruments at various sittings. But, since our conclusions are based upon immediately successive changes in the form of the curve only this is a matter of no moment in the present case.



XVII., Heat; XVIII., Color red, eyes open where arrows occur; XIX., Expected noise; XX., Slight noise; XXI., Cold; XXII., XXIII., Disagreeable odor, capsicum; XXIV., XXV., Camphor.

IX). The breathing, then, at least in the case of the more violent emotions, shows the same functional disturbance which has already been shown to be characteristic of the pulse curves.

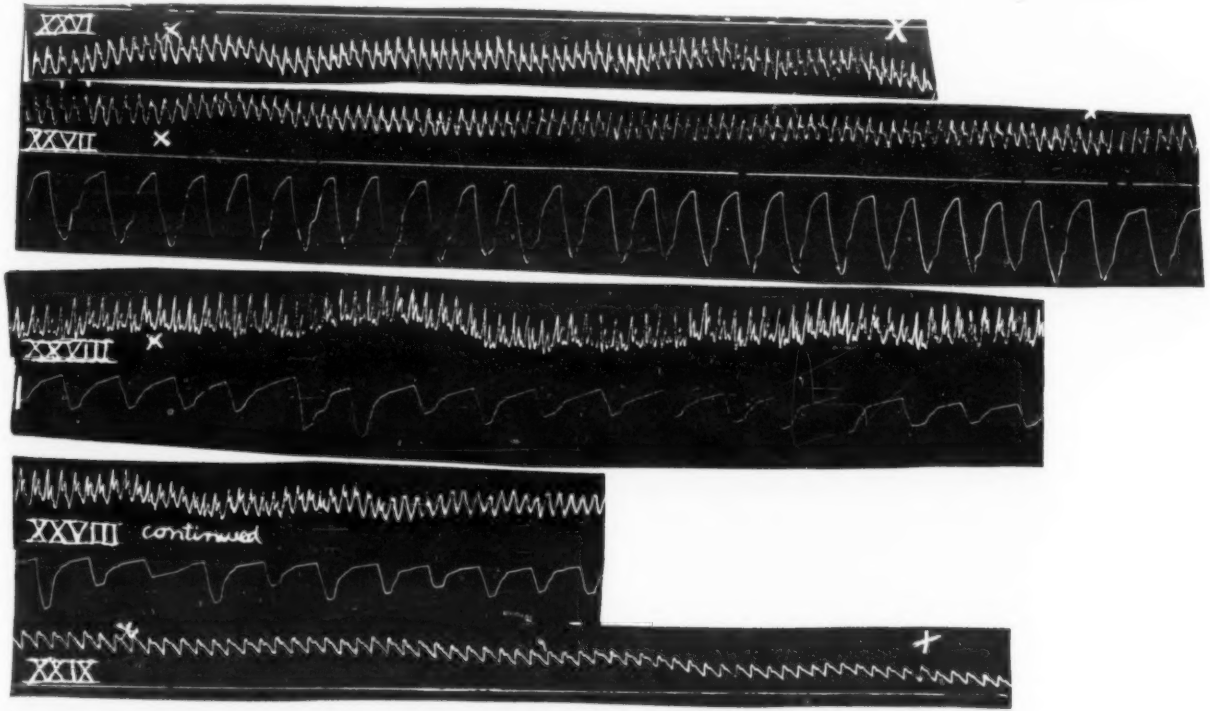
According to the psychological analysis of the states known as emotion, sensation and intellectual application, which was offered in the preceding section, we found that, when classified with respect to the stability of the attentive process involved, sensation occupies a middle range between emotion and mental application. It was also pointed out that the term sensation covers a great variety of experiences, some of which border closely upon emotional states, while others approach the intellective conditions. If the hypothesis is correct, that the degree of stability of the physiological processes runs parallel with the degree of stability in the attentive process, we ought to find in general the curves for sensation showing less disturbance than those for emotional states, and more than the curves for intellectual application. Moreover, we ought to find the curves representing sensation varying from curves approaching the emotional type to those closely resembling the type of intellectual application, according to the quality of the sensation as regards the functioning of attention. This is exactly the relationship which a study of our curves reveals.

Figs. XI. to XVI., inclusive, are typical curves of sensory stimulation. The first three of the set are taken from one subject, and the last three from the other. A comparison of these curves with the preceding ones of emotional experiences and with the succeeding curves of mental application (Figs. XXVI. to XXXI.) will show that the vaso-motor shifts for sensory stimuli are not so great as those for emotional experiences, but are much greater than those in the mental application curves. The amplitude and rate are less spasmodic and irregular than those for emotional states, but not nearly so uniform and even as the rates and amplitudes of the curves of mental application. The amplitude and rate changes which occur are often equal in amount to those of emotional experiences, but they are less jerky and irregular. They approach more nearly the even, progressive changes of mental application.

But within the large class of psychic states known as sensa-

PLATE VI.

PLATE VI.



XXVI., XXVII., Addition; XXVIII., Memorizing; XXIX., Multiplication.

tion, for which the statements in the preceding paragraph are true in general, we find the wide variations in the accompanying bodily processes which our psychological analysis has led us to expect. Various sensory stimuli produce experiences of widely different intensities. A hot object touching the skin produces a much more intense experience than a colored light impinging on the retina, and, therefore, makes a much more imperative demand for attention. The shift from the preceding state to the new experience is much more sudden and violent in the case of the hot stimulus, and involves a rudimentary shock, which is entirely lacking in the color stimulation. The different bodily processes accompanying these two sensations are shown in Figs. XVII. and XVIII. The sudden violent changes in vaso-motor level accompanying the heat stimulus are much like those of the emotional experiences, while the slight gentle fluctuations of the color experience approach the mental application curves.

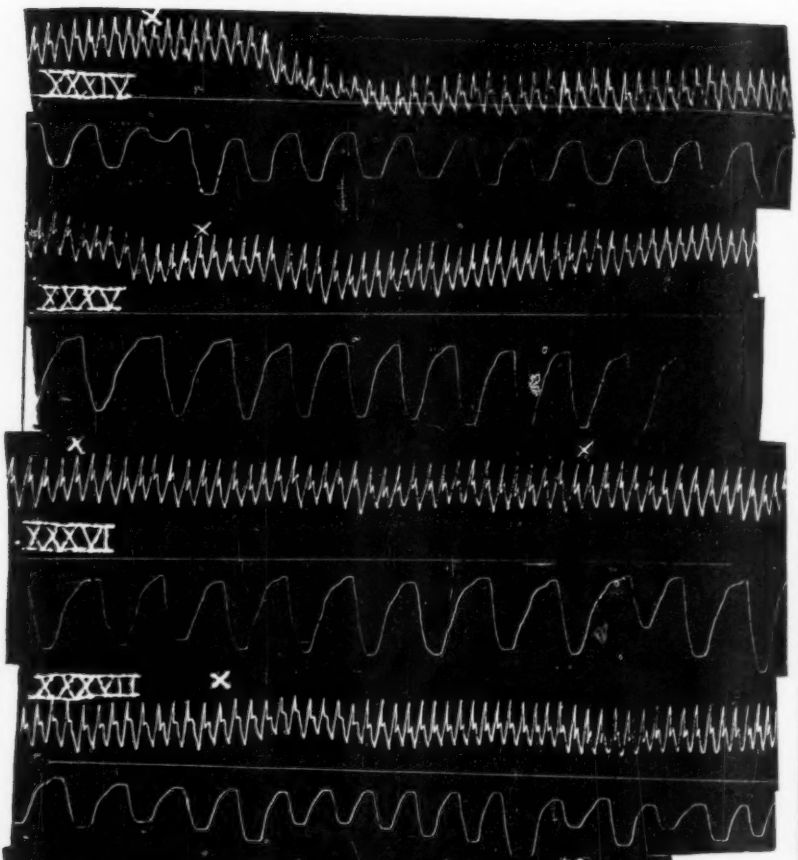
But even the same kind of sensory stimulus occasions states which differ greatly in intensity at various times, according to the actual physical intensity of the stimulus, the nervous irritability of the subject at the moment when the stimulus occurs, and the element of surprise involved. A loud noise, for instance, produces a much greater shock, and a correspondingly greater disturbance in the bodily processes, when it is unexpected than it does when the subject is prepared for it. Fig. XV. shows the effects of an unexpected noise. Fig. XIX. is a curve for noise taken at the same sitting, with the sole difference that in Fig. XIX. the noise was expected. The shock involved in the unexpected noise made the experience take on an emotional tone, which is reflected in the spasmodic change of vaso-motor level and amplitude, while the expected noise produces only a slight irregularity in the curve. When both noises are unexpected, a loud noise produces a much more violent shift of attention than a slight one. Fig. XII. is a characteristic curve for a loud noise, while Fig. XX. shows the effect of a slight noise upon the same subject. The contrast is much the same as that between the expected noise and the unexpected one. Furthermore, a stimulus which occurs while the subject is

PLATE VII.

PLATE VII.

XXX., Addition; XXXI., Multiplication; XXXII., Emotion, thought of friend's illness; XXXIII., Noise.

PLATE VIII.



XXXIV., Capsicum; XXXV., Knocking; XXXVI., Cross 1, Camphor; Cross 2, Rubber Cement; XXXVII., Addition.

nervously excited produces a muc hmore disturbing effect, and makes the readjustment of attention a much more difficult matter, than the same stimulus would if the subject were calm. Fig. XI. is the curve of a cold stimulus which occurred during a state of emotional excitement. Fig. XXI. is also the curve of a cold stimulus, given at the same sitting, but at a time when the subject was calm. The difference in the effect of the two stimuli is entirely disproportionate to the slight difference there may have been between the absolute intensities of the two.

The breathing during sensory stimulations undergoes irregular changes in rate and amplitude, more or less analogous to those of the pulse. An experience intense enough to cause a profound change in one usually shows itself in the other also (see Fig. XI.). When the experience is less intense it sometimes produces an effect on the pulse curve, but none on the breathing, although the reverse seldom happens. On the whole, the breathing in cases of sensory stimulations is characterized by slight spasmodic irregularities, usually of short duration (Figs. XI., XII., XIII., XIV., XXV.). With the weaker and less effective stimuli these are often lacking, and sometimes fail even with the more intense experiences (see Fig. XVII.). As compared with emotional states, the disturbances of the breathing during sensory stimulation are of less frequent occurrence and of briefer duration.

The search for uniformity in classes or kinds of sensory stimuli is as fruitless as it proved to be in the emotional states. An overwhelming majority of sensory stimuli of all kinds, whether agreeable or disagreeable, caused vaso-constrictions. The few cases of pronounced vaso-dilation do not correspond to the distinctly pleasant stimuli. The most distinctly pleasurable stimulus used, harmony, caused constrictions on all of the few occasions when it was given. Unpleasant odors, such as camphor and capsicum, caused dilations on a few occasions. Figs. XXII. and XXIII. are the curves for two disagreeable odors, both capsicum, given within a few minutes of each other to the same subject. As the curves show, one caused a slight dilation and the other a somewhat greater constriction.

The amplitude changes of the pulse curve show no greater

constancy in the direction of change for different kinds of stimuli than does the vaso-motor level. There is a great preponderance of decreases of amplitude over increases for sensory stimuli as a whole, but here again there seems to be no particular significance in the direction of the change for different experiences. For instance, disagreeable odors cause sometimes increase and sometimes decrease of amplitude (see Figs. XXII. and XXIII.). Cold is sometimes accompanied by a decrease of amplitude (Figs. XI. and XIV.) and sometimes by increase (Fig. XXI.). The relatively few cases of harmony among our tests all produced an increase of the amplitude of the pulse curve, a fact which suggests increase of amplitude as a correlate of pleasant experiences, until we notice that discords have the same effect.

The rate changes of the heart-beat during sensory stimulations are about equally divided between increases and decreases. Cold, noise, odors—in fact, all the stimuli of which we have any considerable number of tests—cause sometimes one and sometimes the other in a manner which, on present data, is entirely erratic. The cold stimulation shown in Fig. XIV. causes a slight temporary decrease of the pulse rate, while that of Fig. XI. is accompanied by a progressive increase. Figs. XXIV. and XXV. show the curves for two camphor stimulations, the first of which causes an increase of pulse rate and the second a decrease.

The dicrotic notch changes its emphasis and its position with reference to the apex of the pulse curve with as little regard to the nature of the stimulus as is shown by the other factors. With one subject the dicrotic, when it suffers any change at all, undergoes an almost uniform flattening during sensory stimuli of all kinds. With the other subject it is emphasized almost as often as it is flattened. The position of the dicrotic remains unchanged during the great majority of sensory stimuli for both subjects. When it is raised or lowered it happens apparently without reference to the nature of the stimulus.

The mental application tests used were chiefly simple arithmetical problems given as fast as the subject could perform them. In a few cases the memorizing of a series of nonsense syllables was employed. The curves of mental application are characterized by the slight amount of the vaso-motor changes involved, and

by the even progression in which changes in rate and amplitude take place, when they occur at all. The vaso-motor level usually shows slight fluctuations, although they are always less than the fluctuations of revery for the same day. Frequently the changes are so slight as to be scarcely noticeable (Figs. XXVI., XXVII. and XXVIII.). The respiratory rhythms disappear.

The breathing is more regular in most cases, although there are some exceptions. In memorizing nonsense syllables the breathing curve is broken up by a tendency to pronounce the syllables. In some cases of mental application, such as Fig. XXXVII. there are occasional irregularities. The fact that the breathing is under voluntary control, and that it is immediately affected by any tendency to use motor images of words, would lead us to expect that the uniformities would be less evident in that case than in the case of the purely reflex vaso-motor phenomena. As compared with emotional experiences and with sensory stimulations, and even with revery, the bodily processes accompanying mental application are characterized by greater stability and regularity. If our psychological analysis is correct, mental application is a state in which the attentive process is most stable, runs most smoothly and offers greatest resistance to change. Here, again, the correspondence between the degree of stability of the attentive process and the degree of stability of the accompanying bodily processes holds.

But as in the former cases, so in mental application, the direction of the various changes which do occur, offers no basis of classification which articulates with the psychological classification, either into intellective as opposed to affective states, or into agreeable as opposed to disagreeable states. The subjects found no distinctly affective tone in the various mental application tests used. Since no psychological classification on the basis of agreeable and disagreeable is possible in this case, it would be absurd to intrepret the vaso-dilations and constrictions as having such a significance. If the direction of the changes characterized intellective states as opposed to affective states we ought, of course, to expect to find some uniformity in the direction of change of mental application tests as a whole. But this is entirely lacking. In almost half

of the mental application tests the vaso-motor level shows both dilations and constrictions within a single test (Figs. XXVI., XXVII. and XXVIII.). Where the vaso-motor level changes in only one direction it seems to be an even chance whether it shall be a dilation or a constriction. Frequently there is no change of level. Fig. XXIX. illustrates a mental application test where there is only constriction and Fig. XXXVII. one where there is only dilation.

The amplitude of the pulse curve in mental application shows a greater tendency to decrease than to increase. In all of the few tests made, which exceeded two minutes in time, there was a marked decrease of amplitude at the end, even when there was an increase at the beginning. But among the tests of shorter duration there were several where the amplitude increased without any subsequent decrease. The pulse rate of mental application shows a greater tendency to increase than to decrease, but the cases of decrease of rate, although less numerous than those of increase, are frequent.[1] But, whatever the direction of the change, it takes place slowly and gradually. (See Fig. XXXVII. for increase of pulse rate and Fig. XXXI. for decrease of rate.)

The rate and amplitude of the breathing curves change in contrary directions during mental application in quite as erratic a manner as the pulse curves.[2] One subject shows an almost uniform increase of breathing rate, while the other has a few more cases of decrease than of increase. With both subjects the amplitude is more often decreased than increased, but there are frequent cases of increase. (See Fig. XXVII. for increase of breathing amplitude and Fig. XXXVII. for decrease.)

As a summary of the results of these experiments, we can offer nothing better than a series of tests illustrating each of the different types of processes from curves obtained at a single sitting of about an hour's duration. There is first the emotional experience of the sudden thought of a friend's illness (Fig. XXXII.),

[1] Most investigators report much greater constancy in the cases of increase of rate in the heart under these conditions. Certainly it is the most usual occurrence.

[2] MacDougall and the French writers report increase in rate and decrease in amplitude as constant. Delabarre's observations suggest a considerable difference in individuals in this respect.

with its marked fall in vaso-motor level and its irregularity in all the features of pulse and breathing curves. Next comes the startling noise (Fig. XXXIII.), which involves as sudden and violent a shift of attention as the emotion and produces a very similar curve. Next in order is a disagreeable and annoying odor—capsicum (Fig. XXXIV.). In this case the vaso-motor fall is less, though still very evident, and irregularities in amplitude and rate are decreased. The slight disturbance caused by an unexpected knock at the laboratory door, makes still less of a fall in vaso-motor level, but yet shows other irregularities (Fig. XXXV.). The odors of camphor and rubber cement, which were not at all annoying unless strong, produce no marked change in the curve (Fig. XXXVI.). The slight shifts of vaso-motor level, and slight irregularities of rate and amplitude, resemble closely those of the preceding state of revery. No strong demand for attention is made by them. Finally, mental application (Fig. XXXVII.) produces a steady strain of attention, which is accompanied by a curve practically devoid of fluctuations in vaso-motor level, with an amplitude which is almost constant, and a slowly, progressively increasing rate.

All the processes with which we have been dealing are cases of readjustment of an organism to its environment. Attention is always occupied with the point in consciousness at which the readjustment is taking place. If the process of readjustment goes smoothly and evenly, we have a steady strain of attention —an equilibrated motion in one direction. The performance of mental calculation is a typical case of this sort of attention. But often the readjustment is more difficult. Factors are introduced which at first refuse to be reconciled with the rest of the conscious content. The attentive equilibrium is upset, and there are violent shifts back and forth as it seeks to recover itself. These are the cases of violent emotion. Between these two extremes comes every shade of difficulty in the readjustment, and of consequent intensity in emotional tone. We have attempted to show in the preceding paper that the readjustment of organism to environment involves a maintenance of the equilibrium of the bodily processes, which runs parallel with the maintenance of the attentive equilibrium, and is an essential part of the readjustment of the psychophysical organism.

PROFESSOR MÜLLER'S THEORY OF THE LIGHT-SENSE.[1]

BY CHRISTINE LADD FRANKLIN.

Professor Whitman, in his address as Vice-President of the Section of Physics, has given an admirable account of the present state of discussion upon the color-sense, as far as it regards the theories of Helmholtz and of Hering, and he has also devoted much time—more, perhaps, than they deserve!—to the modifications of those theories which have been made by Ebbinghaus and v. Kries. He has, very politely, refrained from anticipating what I have to say by giving an account of the subject of this paper, the theory of Professor G. E. Müller, a theory which, in my opinion, deserves to be put quite in the front rank of the various attempts that have been made to account for the color-process of the retina. I regret very much that this paper of Professor Whitman's was given before the physicists at an hour when it could not be listened to by the members of this Section, for it contained a very clear account of the recently discovered facts of color-vision, a knowledge of which, on your part, would perhaps have lent something more of interest to my discussion of the theory of Professor Müller.

This theory is set forth in four papers which have been printed in 1896 and 1897 in the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane;* these papers cover some two hundred and fifty large pages, and form therefore practically a book on the subject. The appearance of this volume, as it may properly be called, marks a real epoch in the long discussion that has been going on in the effort to reduce to order and system the phenomena of the sensation of light. Its author has shown a remarkable mastery of the immense mass of facts which have a bearing upon the case, and a no less remarkable keenness

[1] Read before the Section of Anthropology, A. A. A. S., August, 1898.

of logic in attributing to them their proper weight in the discussion of theoretical considerations. Professor Müller won his spurs, as a young man, by his very acute treatment of the fundamental problems of psycho-physics; his reasoning processes are of a far more rigid character than those which are usually consecrated to the subject of color-vision. His theory presents great points of superiority over the Hering theory, and it is by far the best attempt that has yet been made to construct a theory based upon the assumption of antagonistic retinal processes for the colors and for white and black.

Professor Müller himself modestly refers to his theory, in many places, as merely a modification of the theory of Hering; at other times he speaks of it plainly as *die hier vertretene Theorie*, in distinction from that of Hering. There is no question that the latter designation is the correct one. When a theory has some points in common with another it is difficult to know just where to draw the line between regarding it as the same and regarding it as different—it is impossible to lay down any general rule that shall cover such cases. In regard to the extraordinary fact of color vision—so totally unlike anything that happens in sound or in any other quality of sensation—that when certain two colors, which are neither particularly alike nor particularly unlike, as far as one can tell beforehand, are seen together, they both absolutely *disappear* from consciousness, that their place is taken by a plain undifferentiated gray—in regard to this fact[1] there are, in two different respects, two different lines of explanation. In the first place, this extraordinary fact of disappearing color-pairs may be a matter of physiology or it may be a matter of psychology,—that is, it may be (in the latter case) that it is the judgment, or rather the imagination, which causes us to lose all sense of color in the sensation of white, or it may be, on the other hand, that the loss takes place in some lower stratum of the passage from external light to the

[1] It is an act of discourtesy to the adherents of one or the other of the two great schools of color-theorists to call such color-pairs as this either *antagonistic* or *complementary* colors, for either term commits us at once, of course, to an opinion as to the intrinsic nature of the processes which call them forth. The difficulty can be avoided if we refer to such a pair of colors as a *disappearing* color-pair.

final sensation—for instance, in the photo-chemical process, whatever it may be, of the retina. In each of these two cases the loss of color may be of the nature of a *composition* into a resultant gray, or it may be of the nature of an *antagonism*, and a suppression of color, with the re-emergence of a gray which was present all the time in a state of abeyance or of concealment.[1] The only psychical theory that has been proposed hitherto is the Young-Helmholtz theory; but there might equally well be a psychical antagonistic theory, in which, by the action of the mind, the colors of a color-pair, upon proper occasion, destroyed each other. This theory would have quite as much reason in its favor as the psychical complementary theory of Helmholtz, and it is merely by an oversight, no doubt, that it has not yet been seriously proposed.

If the cause of the disappearance of color is physiological, it may, as I have said, be either of the nature of a re-composition of the several constituents of white, or of the nature of an antagonism, and a suppression of color. Now the theory of Müller belongs to the same one of the four possible classes of theories as that of Hering—it is physiological and antagonistic. But that is not enough to make it the same theory. If the assumption of four antagonistic colors and a separate process for black and white were sufficient to characterize a theory, then the theory of Hering would not belong to Hering, for all that was maintained by Mach for ten years before the appearance of Hering's first paper on color-theory. What *is* distinctive of the Hering theory is the assumption of assimilation and dissimilation as the bases of the antagonistic sensation-pairs. For this Professor Müller substitutes the conception of 'reversible chemical action,' and he shows conclusively the utter inadequacy of the processes of assimilation and dissimilation to play the part required of them. (Aside from all other difficulties, they are not even antagonistic processes; dissimilation does not inhibit assimilation, but, on the contrary, the more rapidly any tissue is being used up, the more quickly does nature hasten to restore

[1] Thus there are four possible classes of color-theory—the psychical and the physiological compository theories (or complementary theories) and the psychical and the physiological antagonistic theories.

it.) This difference in the character of the antagonism concerned is very fundamental—so much so that in the one case (that of the assimilation and dissimilation of Hering) it is quite impossible to accept the theory based upon it, while the other theory (that of Professor Müller) is not to be so lightly brushed aside, but, on the contrary, gives room for serious discussion. I have, therefore, no hesitation in designating the theory of Professor Müller as a *new* theory, although it is a theory belonging, like the theory of Hering, to the class of physiological (instead of psychical) theories, and to that of antagonistic (instead of complementary) theories.

Professor Müller's paper begins with an acute discussion of the doctrine of psycho-physical parallelism. He sets forth the several axioms, five in number, into which that doctrine may be resolved. He shows that Hering has violated these principles in a fundamental manner, in assuming that the quality of a sensation of gray depends only upon the *proportion* of black and white which enter into it, while their absolute amounts may vary to any extent without affecting sensation. This palpable defect in the theory of Hering is removed by Müller by the assumption that the effect of light upon the black-white photochemical substance is such that whenever more white process goes on, by just so much there is less of the black process, and hence that a given *proportion* does not, as matter of fact, occur with different absolute amounts of the two elements which make it up; if it did, we should see a given *quality* of gray in various different degrees of *intensity*, what is not the case.

Another application of the principles of psycho-physical parallelism is made by Professor Müller to determine what he calls a psychic quality-series. Sensation is subject to ceaseless change; we assume it as self-evident that we are capable of distinguishing whether a sensation is varying *in a constant direction*, or not; if, for instance, we are making a purple light out of a physical mixture of red and blue, we shall assume that we can distinguish between the several cases, whether the operator is adding always more and more blue to the mixture, whether he suddenly begins to add more red, or more white, or more black; if the sensation is growing steadily more and more *like*

a distinct *other* sensation, the series shall be called a series which varies in a constant direction; in this case we are required to assume that the underlying physiological process which immediately precedes consciousness is also in some sense a series which varies in a constant direction; this may be a constant change in quality (a change in a vibration period, for instance), or it may be a constant change in the relative intensity of the two elements of a mixture. Professor Müller shows, by an exhaustive piece of reasoning, that in the case of the color series there is every reason to believe that the latter is the case, that the physiological process is a varying mixture of two processes. This is, in fact, the only supposition that is possible if the physiological process is of the nature of a chemical change (for a chemical change is not capable of a very large number of different qualities); and that it *is* of the nature of a chemical change there seems to be very little reason to doubt. Nothing else would be at all possible except an electrical process, and that, if it took place, would be due to a preceding chemical effect; so it is simpler, in the absence of reasons to the contrary, to assume a chemical effect only.

The question which next arises is this,—and it is a very important one. Does the whole gamut (a circular gamut) of saturated color-tones correspond to one or to more than one, and if to more than one, then to how many *psychic quality series*, in the above sense of the term? It is plain that there are *four* such series in the whole congeries of color-tones. The end members of the series are the fundamental colors, red, yellow, green and blue. Four fundamental color-tones have been assumed before, but many psychologists have objected to the grounds upon which both Mach and Hering urged the claims of these four colors to their exceptional position. They have said that in looking at an orange color, for example, it is impossible to extract from it the red and yellow of which it is composed, in the same way in which one can hear in a chord its separate notes; and violet does not 'remind' us, they say, of red and blue any more than red and blue remind us of violet. Professor Müller concedes that when we look at the colors *singly* they appear all to be of equal dignity. By simply looking at a

given color, we cannot tell whether it is a mixture or more or less nearly an elementary sensation. The colors must be arranged in quality-series; then the difference between the end members and the intermediate members of these series becomes distinct. Are a given set of quality changes proceeding in a constant direction or not? The colors of the spectrum are not well adapted for obtaining the answer to this question—they differ too much in brightness. It is better to take a complete series of papers, or, better still, of gelatine sheets, which can have their brightness regulated by putting different grays behind them. Then, if one looks on dispassionately, one cannot help saying to oneself: When I pass from red through orange to yellow the change in the quality of the sensation proceeds constantly in the same direction; so when I pass from yellow through olive to green. These are, in the above sense of the term, psychic quality series. But when I pass from orange to yellow and from yellow to olive, or from olive to green and from green to blue-green, the second part of the change is *not* in the same direction as the first—these color-sensations are *not* members of one and the same quality series. For a person who cannot perceive the difference that is here insisted upon, there is indeed nothing to be done; but to the unprejudiced observation it may be confidently predicted that, if we put in say five, or seven, color-tones between purple and orange, through the reds, and also between red and yellow, through the various tones of orange, the difference in character of the two series will 'spring into the eyes' with perfect distinctness.

All Professor Müller's discussion of this subject, of which I can give only a brief indication here, I regard as excellent, and I adopt it bodily as a firm substratum for my own theory. But, unfortunately, it does not fit Professor Müller's theory well at all. In order that the four colors which a careful inspection of our sensations tell us are fundamental may also be antagonistic (or, in the phrase of the other theory, *complementary*), it is necessary to manipulate those colors a little. The blue and the yellow which consciousness tells us are end-members of psychic series are, it is true, also complementary; but green (in any ordinary signification of the word) is not complementary to red

at all. In order to make things fit, Hering is obliged to assume as green a color which the unbiased eye would pronounce to be a distinct *blue-green*. (As confusion is constantly arising from the fact that the simple word *green* has two totally different significations, according as one is speaking in the language of Hering or of Helmholtz, I propose to modify the spelling of that green which is in reality a blue-green, and to write it *grehn*, meaning by this word *the green of Hering*. It is then *grehn* and not *green* which is the complementary color to red.) Now, this beautiful structure of the psychic quality series goes all to pieces as soon as we attempt to fit the Müller-Hering theory to it; the *grehn* which is the complementary or antagonistic color to red is *not* an end-member of a psychic quality series, but it is a member which comes very distinctly in the middle of such a series. While then this whole discussion of Müller's gives my theory a firm standing-ground against those psychologists who profess not to be able to see that orange is a mixture, it works immediate destruction to the theories of Müller and of Hering.

The central idea of the theory of Professor Müller is, as I have said, that of a reversible chemical action. (Assimilation and dissimilation are *opposite* chemical actions, in a sense, but they are not reversible—the products of dissimilation are not reformed into the original tissue.) Professor Müller places at the head of his presentation of his theory this passage from the *Theoretical Chemistry* of Nernst: "We were formerly of the opinion that the reversible reactions belonged to the exceptions, or that it was necessary to distinguish between two different classes of reactions, the reversible and the not-reversible. But we know now that a sharp limit of that kind is wholly non-existent; there can be no doubt that, upon proper arrangement of the experiment, every reaction can be caused to proceed now in one and now in the other direction—that is, that every reaction is, in principle, reversible." This very modern idea of the chemist furnishes the basis for Professor Müller's conception of the antagonism between the fundamental retinal processes, and he refers here not only to the color-pairs, red-grehn and blue-yellow, but also to the connected

pair of sensations, black and white: that is, he conceives that the 'proper arrangement of the experiment,' which Nernst says is the only condition necessary to make chemical reactions reversible, has been secured for the vertebrate retina. Confining himself at first to the black-white pair of sensations, in order to facilitate speaking about them, he goes on to *préciser* his conception of the retinal chemical process at the base of them in these terms. A white-reaction, expressed in quite general terms, consists in this: that α molecules of a substance A, β molecules of a substance B, γ molecules of a substance C, etc., come together in order to form α' molecules of a substance A', β' molecules of a substance B', γ' molecules of a substance C', and so forth. And then a black-reaction consists in α' molecules of A', β' molecules of B,' etc., returning to their original places so as to form again α molecules of the substance A, β molecules of B, etc. This chemical reaction may be expressed in this form:

$$\alpha A + \beta B + \ldots \rightleftarrows \alpha' A' + \beta' B' + \text{etc.} \qquad (1)$$

If this is read from left to right it is a white-reaction; if it is read from right to left it is a black-reaction.

Nothing, of course, is to be said as to the actual degree of complexity of these reactions, that is, as to the number of the substances, on the right hand and on the left, which are involved in them; they may be numerous, or they may be one only. In any case the total amount of the substances A, B, C, etc. constitutes the white-material which is present, and the amount of the substances A', B', C', etc. constitutes the black-material which is present; the separate substances, A, B, ... A', B', ... are the components of the black and of the white material respectively. For a chemically homogeneous portion of that layer of the retina which is sensitive to light, the *intensity* of the white process will be equal to the number of white reactions which take place in unit volume of the retinal substance during an element of time. The law of mass action, which plays an important rôle in his theory, will then be exhibited in this form:

$$J_w = \frac{K_w a^\alpha b^\beta c^\gamma \ldots dt}{v^{\alpha+\beta+\gamma}}$$

where a, b, c, ... are the masses of the photo-chemical substances (expressed in gram-molecules) α, β, γ, ... are the numbers of these present in a given portion of the substance, v is the volume of that substance, and K is a coefficient, depending upon the temperature and other factors, which may be called the specific velocity-coefficient of the white-process. We have a similar expression for the intensity of the black-process. But as there is no occasion for concerning ourselves with the separate components of the black and the white material, we may write these equations

$$I_w = K_w M_w \, dt,$$
$$I_s = K_s M_s \, dt,$$

with similar expressions for the two pairs of color-processes. This is simply the mathematical expression of the fact that the intensity of any photo-chemical process in the retina is proportional to the amount which is present of the material of the reaction in question. Stated in this way, it does not seem to be a proposition which any one need hesitate to admit.

It will be seen that the theory of Professor Müller, in making use of the ideas of the *reversible chemical process* and of the *effect of mass-action*, is a theory of the very highest fashion. Let us see in detail how he overcomes the discrepancies which exist in the theory of Hering. A chief objection to the view of Hering, for those who have been interested in its theoretical aspect, is the inconsistency which meets us at the very beginning; why should black and white be regarded as an *antagonistic* sensation-pair, when they do not destroy each other, but give us, on the contrary, the whole series of grays? Professor Müller, in his general rectification of Hering's theory, has devised an ingenious means of meeting this difficulty. He assumes that the black and white chemical processes *do* exactly neutralize each other when they take place in equal amounts *in the retina*, but that there is a continuous black-white excitation going on in the *cortex* (unaccompanied by any color-excitation), that that is the cause of the so-called self-light of the retina—the faint gray sensation which we are never free from though the eyes are closed—and that any gray excitation sent up

from the retina is added to or subtracted from this endogenous cortical excitation, corresponding to an antagonistic pair of colors, according as the black or the white predominates in it. If the black and white processes are equal in amount, no additional excitation of the brain is sent up from the retina, and the self-light is the only sensation experienced. But this is to introduce a fresh difficulty as serious as the one which it is attempted to remove. Why should not the yellow-blue substance of the cortex be subject to a continuous excitation as well as the black-white substance? If the two pairs of chemical processes must be so unlike in the end, why take the trouble to make them so like in the beginning? The situation is this: for *sensation*, black and white constitute a psychic-quality series (in the above defined sense of the term), while yellow and blue do not; as regards the *assumed chemical processes*, the one for the yellow-blue series is finally antagonistic in the retina, while the one for the black-white series must have a distinct and additional process which can be superimposed upon it in the cortex. Is it not much simpler to admit once for all that black and white do *not* stand to each other in the same relation as yellow and blue (nor as red and grehn)? Why force them into an unnatural resemblance which they must immediately afterwards be despoiled of? Why introduce a wholly unnecessary difficulty into a theory merely for the sake of showing with what ingenuity it can afterwards be done away with? This whole construction of chemical processes is at best purely an imaginary one; absolutely the only virtue that it can have is the virtue of consistency. The idea of black and white occupying the same place, in a proposed system of explanations, with a disappearing color-pair is, *von vorn herein*, most causeless and most unfortunate, and no amount of bolstering up by subsidiary hypotheses can make it anything else. Professor Müller's real ground for executing this *tour de force* is that he conceives it to be demanded by the phenomena of constrast, successive and simultaneous. The fact that unless black and white are regarded as a perfectly congruent sensation-pair with yellow and blue (and red and grehn), the explanations of contrast and of after-image do not run exactly *pari passu* for colored and for colorless sensations, is

regarded by Müller as a fatal objection to every theory except his own and that of Hering. As matter of fact, Helmholtz gave too much importance to the psychical elements involved in contrast, and we are all now convinced that the correct explanation is to be looked for along physiological lines—a conviction which we owe to Professor Hering and one for which our gratitude is due him. But every explanation of contrast which can be given in the language of Hering and of Müller can be given just as consistently in the language of any of the complementary color theories; it is true that it will read a little differently according as the contrast to be explained is one of colored or of uncolored surfaces, but that, instead of being a defect, is altogether a point of merit; since the grays do not constitute a series of the same nature as the mixtures of yellow with blue (or of red with grehn), it is a feature of extreme ineptitude when their contrast-effects are explained in exactly the same language.

An admirable chapter in Professor Müller's work is his discussion of the visual purple, as it was unfortunately named, since it is now known pretty positively that it is not a chemical basis for *vision* any more than it is *purple* in color, in the English meaning of that term. Professor Müller adopts my assumption that the rod-pigment (as I prefer to name it) is a secondary means for securing adaptation to a faint light, and not directly a vision-producing substance at all; I suppose that it acts by absorbing (for the purpose of re-enforcing faint-light vision) a large amount of the light which usually passes entirely through the transparent rods and cones to be lost in the choroid coat, and Professor Müller takes it as acting as a sensibilisator, in the photographer's sense of the term. In Professor Müller's assumption, its *color* has no significance. In mine it is of great importance; it is adapted to aiding vision in the gloomy depths of forests, because green light is the light which it absorbs; and fishes, which alone, of all vetebrates, have a rod-pigment of a distinctly different color, are exactly fitted for utilizing the last rays of the light which penetrates deep into the water of the sea. v. Kries opposes this view, and he is led thereby into countless inconsistences and contradictions (especially in regard to the gray-vision of the periphery of the normal

eye). He goes so far as to regard the rods as functionless whenever they lack their purple coloring substance.[1]

The progress of our knowledge of color-blindness forms one of the interesting chapters in the history of science. The Young-Helmholtz theory of three (instead of four) fundamental colors having been taken as *fact* instead of theory, the conclusion was jumped at that a defect in color-vision must consist in the absence of some one or more of these three colors, and the common forms of the defect were described as red-blindness and as green-blindness. By a very brilliant piece of reasoning, it was discovered, about 1850, by William Pole, F.R.S. (professor of Engineering in University College, London, and author of the well-known work on whist), who is himself color-blind, that as matter of fact the sensations experienced in both cases are blue and *yellow*, instead of blue and red or blue and green. This discovery did not awaken as much interest as it ought to have done, and the reasoning by which it is established, cogent as it is, did not prove convincing to all; Sir John Herschel said, "What the sensations of the color-blind really are we shall never know with certainty." It happened not to occur to him that there was a possibility of some individual being color-blind in one eye only. It was only after the true state of the case had been put wholly beyond question by several cases of monocular color-blindness that it became matter of common knowledge—in fact, it continues to be most unaccountably ignored in England to the present day. This fact, that the senses for red and for green are lost together and that the color-

[1] It has lately been affirmed by Sherman and others that there is a certain amount of change in the relative brightness of the different portions of the spectrum for the rodless regions of the retina when the light is diminished—that is, that the Purkinje phenomenon is not wholly wanting there—an amount so small however, that it has been denied to exist by other observers. This would be a fact very damaging to the assigning of the adaptation-function to the visual purple, if it could not be explained. It can, however, be explained very easily. Kühne, who is still the chief authority on changes in the photo-chemical substances of the retina, expressly states that the yellow coloring matter of the macula is subject to a slight change in quantity with a changing intensity of the illumination; the change in relative value of the blue sensation which is affirmed to exist by Sherman is, therefore, just what is needed to parallel this physiological variation in the amount of a colored substance which absorbs blue light.

vision which persists in these cases is vision for blue and yellow, was taken, and very properly, as working immensely to the good of the theory of Hering. But immediately it appeared that the situation was not so simple as it had seemed to be; while the warm end of the spectrum is seen by all alike as yellow, nevertheless there are still two classes of these defectives as regards *what part* of the warm end of the spectrum is seen to be of the *brightest* yellow; and these classes are totally distinct—there are no intermediate cases. It is as if red-vision had fallen out and green-vision had been turned into yellow-vision for the one sort; and for the other sort it is as if green-vision had fallen out and yellow-vision had taken the place of red-vision. Hering denied for a long time that there is anything in this difference, more than can be explained by individual differences in the yellow coloring matter of the macula. But Müller admits the fact, and endeavors to account for it. The red light of the spectrum, he assumes, besides its effect on the red-green substance, may have also an effect on the yellow-blue substance, and it may even have two such effects—it may act upon it in the first place directly, by producing out of the decomposition of the red-green substance some one or more of the constituents of the yellow material (with which, in the original form of the hypothesis, red light had nothing to do). The first type of the red-green blind—those formerly called red-blind—are totally lacking in the red-green substance; these are the typical yellow-blue visioned. But the second type—those formerly called green-blind—see yellow in the place of both red and green for some totally different reason—either because the nervous fibres which conduct the retinal excitation are not of the normal constitution, or because some still other constituent which is usually found already prepared in the retina is now absent. In this fashion it will be seen that the so-called red-blind lack all the *indirect* effect of the light of the spectrum upon the yellow-blue substance, while that indirect effect still persists for the green-blind. It is plain that this is an explanation which is complicated and far-fetched in the extreme.

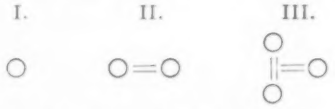
The value of a theory which is offered as explanation of any series of connected facts can be determined only by the

method of comparison with the other theories which it is proposed that it should replace. Any theory is better than no theory, and the theories of Newton, Young, Helmholtz and Hering have filled a useful function in giving direction to the immense amount of work which has been expended upon this subject in laboratories. But as soon as theories are thought out which offer a more probable and a more natural conception as to the nature of the unattainable link between external light and conscious light-sensation, then the usefulness of the provisional theories is at an end. It has been said, within a few years, by the Vice-President of this Section, who is also one of the editors of the PSYCHOLOGICAL REVIEW, that the best theories now in the field are the theory of Donders, that of Wundt and my own; in this opinion I heartily concur! In all of these theories the attempt (which is fore-doomed to failure) to represent the black-white series as of the same nature as a self-destroying color-pair, although it is plainly a non-self-destroying pair of sensations, is given up. Black is regarded as a sensation which is connected with white not differently from the way in which it is connected with blue or with green, or that in which blue and green are connected with each other. By this means the ingenuity which is required to explain the fact that black and white do *not* destroy each other is rendered unnecessary—there is no reason why they should destroy each other, for they are in no sense antagonistic. These three theories are all of the physiological type: the cause of the mutual destruction of a color-pair is in the retina and not in the imagination. Two of them are of the component type; the other (that of Wundt) is of the antagonistic type. Wundt, as matter of fact, assumes more than four elementary colors, but there is no reason whatever why he should do so. If Wundt were to accept Professor Müller's demonstration of the fact that there are, for consciousness, just four—no more and no less—elementary colors, and if he were to translate into the language of his own theory all the Hering-Müller explanations of contrast and after-image (which are, in reality, not explanations at all, in the correct sense of the term), his theory would be an admirable one.

My own theory possesses the simple advantage that it is able

to assume all the good points of all the other theories, and to avoid all their bad points! It takes on, for instance, the whole doctrine of the color-triangle, which is a *bête noire* for Hering, but which nevertheless is the expression of a vast body of *fact* in the domain of color-mixture; and it takes on the whole new doctrine of the perceptible psychic quality series of Müller, which renders absolutely necessary the assumption of four elementary colors instead of three, but which is destructive to Müller's own hypothesis, because the green which it takes as elementary cannot possibly be *both* an end member of a psychic quality series and the antagonistic color to red.[1] Moreover, there is no explanation of any fact of contrast which is given by the theory of Müller which cannot be given just as well by my theory and in quite parallel terms. The idea of a partial chemical decomposition is in no sense more speculative than that of a reversible chemical process. A reversible chemical action has no distinct analogy in any other known physiological

[1] While my theory assumes four fundamental colors, red and green are nevertheless not complementary. I represent diagrammatically the progressive development of a color-substance in the retina in this way:



I suppose that a primitive undifferentiated substance is composed of molecules which (though they may be of any degree of complexity) are indifferently completely destroyed by light of every wave-length; thus in a later stage the substance consists, in each of its molecules, of two distinct parts, one fitted to be shaken to pieces by light from the warm end of the spectrum and the other by light from the cold end of the spectrum; and that in a third stage of development the yellow-producing constituent is in its turn broken up into two parts of such different internal vibrative periods that they respond respectively to the red light and the green light of the spectrum. (It cannot be said that there is anything repugnant to the ideas of the chemists in this representation of molecules; this very diagram III. has lately been used in another connection as a picture of a molecule by Duclaux.) Partial color blindness is an atavistic condition in which the second stage of development is permanent, and in total color-blindness the entire color substance remains in the primitive condition in which gray is the only sensation produced. Blue and yellow are complementary colors, but red and green, when acting in conjunction, re-compose the yellow-producing substance out of which they have been developed, instead of together making white. In other words, the fundamental green of this theory is a real green, and not the evident blue-green of Hering.

process; but we have not far to go for an analogy for a partial chemical decomposition—the retina itself presents in the rod-pigment (which is first broken down into a yellow substance and then into a colorless substance) exactly the analogy which is required. And this is not all: it seems to have been made out by Hamburger and by Köttgen and Abelsdorff that this decomposition in two successive stages occurs in no animals lower than man; this is an instance of a progressive differentiation of function in an adjunct photo-chemical substance which is exactly what is needed to form a parallel case with the development of a color-substance subject to a partial decomposition out of an undifferentiated gray-substance, which is what my theory requires.

SHORTER CONTRIBUTIONS AND REPORTS.

PROFESSOR GROOS AND THEORIES OF PLAY.

Professor Groos's book on Animal Play—to which renewed attention is given by its appearance in English dress—invites discussion and criticism from several points of view. In the first place, we must regret that human play is deferred for separate treatment, for assuredly the child is preëminently animal in its plays. A monkey which delights in snapping open a match-safe and a child which does the same are at the same stage and should be treated together. To divide plays into animal and human, and animal, into plays of birds, mammals, etc., has little significance.

Professor Groos sets forth elaborately the practice theory of play. Play is the expression of developing instinctive tendencies, an anticipatory, tentative practicing, which accomplishes no immediate serious service. Thus the kitten pounces on the straying leaf, and so practices for pouncing on its prey. We may express it by saying that Nature here shows her prentice hand, or that here is Nature's school, but no forced attendance, no specified time, no set lessons, and only free, spontaneous, pleasant activity. Under natural selection this play period of instinct has been developed, wherein the energies of the protected young act in non-serious forms in preparation for mature life.

To this theory of play we must object that instinct as such needs not practice, and again that instinct fully formed at birth is the more advantageous. If the kitten could at once seize a mouse as a chick does a grain of wheat, it would be much to its advantage. If the prey of cats were of definite size, color and motion, and always appeared at the same distance, an instinct would work at the first occasion; but as it is, instinct cannot cover the varying complexity, but intelligent play practice is called in. The kitten has the instinct to spring, but the regulating for size, distance, etc., is acquired intelligently. The learning may be by hereditary impulse, but yet it is better to define play in terms of intelligence rather than in terms of instinct.

But much of the developing activity of animals can scarcely be brought under the term play as psychic. Thus the young bird, flut-

tering and trying its wings, seems not playing, but serious, as also the child taking its first steps. But when the bird becomes skilled in flying, it flits playfully, and when the child is able to run easily, it delights in running plays. A large proportion of Professor Groos's examples of play fall under work. The imperfect, immature, practice is not thereby play, as, for instance, the calf sucks your finger as seriously as it does the teat. Real sucking play we see in children sucking through straws. Play belongs to childhood rather than to infancy, though both are full of developing activities.

We must, then, dissent from bringing all the inceptive preliminary activities of young animals under play. Further, it is not proved that play as fact of biologic history originates in these activities. Has it yet been shown that play does not appear first as life method among organisms adult from the start, long before a youth period emerges? Some micro-organisms seem to swim playfully, and a sham alarming and attacking is seen among adults low in the scale of life. It is quite conceivable that play started with adult practice, and was conserved and developed through natural selection, at length becoming most prominent in earliest phases of life period, and so making the youth time. The adult practicing among his mates must be harmless, and so easily became sportive, that is, practice-work became play, a pleasing method of unreality.

Another outlook for the origin of play is in the one-sided form, teasing. A very combative animal, having no enemy to fight, will be led to attack its mates, but not violently, as that would break up all its associations, but teasingly. This tendency is so strong in the horse that we have the term 'to nag.' The tricks of boys and the chaffing and practical jokes of men are plainly a low form of play, and perhaps point toward the primitive form. The scare game is also a very popular and crude play with animals and children. To rouse real though groundless fear gives an aboriginal delight in sense of power both to achieve and deceive. After a time the teased one would learn that its best defense is not to resent, but to play back, and hence arises full, two-sided, mutual play. The teasing hypothesis of the origin of play is, like practice of young or adult, a possible mode which ought to be kept in mind by the investigator.

One point which deserves notice in this connection, but which does not appear to be touched on by Professor Groos, is the relation of the play of domestic animals to the play of their wild congeners. Though the dog has been domesticated for millenniums, its play is wild and wolfish, and so contrary to practice for its adult life. The colt

in its play rears, kicks and bites—wild habits which have to be overcome in its domestic life. The colt does not play at drawing loads, nor the collie at driving sheep. Selection by man is but a kind of natural selection, and we might expect some preparatory play, or at least some reduction in the period of wild play. But is this the case? Though young domestic animals do not have tame plays, yet they may play at work taught by man, as the elephants at Bridgeport sometimes playfully practice standing on their heads. It is probable that many wild animals are more playful than their tame congeners largely because intelligence and alertness are more required in the wild state. Wild sheep are a case in point. But if man had bred the sheep for intelligence rather than wool, would not the domestic sheep be more playful than the wild? Some breeds of dogs, being bred for their playfulness, are doubtless far more playful than any wild dogs. But what we need here, as everywhere on play, are data.

Another point which is not considered by Professor Groos is the close relationship of play and work, which requires a study of both to understand either. The life of animals and children is a complex of play and work, a rapid passing from one to the other. Man, adult and civilized, is the only persistent player or worker. Birds in building or nesting seem to be continually interrupting play with work and work with play. A boy begins to pile wood in the shed as play, but as soon as it is felt to be work he ceases, unless you offer a wage. The start is often play, but the continuance work. In most plays the pressure of companions makes some continue playing against inclination, that is, makes them work. From dead earnest to pure play is a long series of mergent psychoses. Pure play and work are rare, most activities being merely dominantly one or other.

We have noted that preparatory activity of young is not always play, and *vice versa*. Thus the fledgling, coaxed and compelled in its learning to fly by its parents, is plainly working, and the colt rearing, kicking, and doing just what he must not do as adult, is plainly playing. Now, both reversion and recapitulation are practically ignored by Professor Groos. But it is certainly worth inquiring whether play tendencies of survival origin may not exist, say among monkeys. Is not there a general psychic embryology which has play forms? The place for reversion in the play of youth is evident in such actions as climbing, swinging, playing with stones, animal plays and plays with animals, deceit plays—civilization is founded on truth—hunting, fishing, camping. That these latter sports appeal little to the gentler sex may be due to the inherited reminiscence of camp

drudgery of savage life, and the fact that the excitement of the chase was not then their part. Indeed, anticipatory play is more common with woman than reversionary, because reversion is mainly joyless. If the work methods of past life are the plays of to-day's life, the works of to-day will be the play of 'beyond-man' millenniums hence.

If we divide all conscious activities into work and play, we have a difficulty in distinguishing them in the *plexus* of life. Take the commonest actions in daily routine, as the morning toilet. Here, many are merely mechanical, and so neither work nor play. But so far as consciousness enters it is generally work for men and play for women. In walking down town one will often go several times through the variations of work, play and the mechanical. But play is constantly emerging in life as activity for its own sake. Thereby it is amateurish, is not a means, and has no wage. Is then pleasurable work play? Professor Groos remarks (p. 253) that bird courtship, while being set a 'real end, yet may have the psychological aspect of mere play,' because of 'satisfaction' in the exercise. But we think that 'satisfaction' applies to work. Work-pleasure is satisfaction in results achieved by effort, but play-pleasure is not satisfaction; rather it is the immediate, fleeting, inherent pleasure in the act itself. Fresh, free, joyous spontaneity is the mark of play, which begins, ceases, rebegins when, where and how it pleases. And play-pleasure has no form of its own, but is that of power, skill, competition, possession, etc., that is work-pleasure, so pointing to work as the origin of play.

Professor Groos's definition of play, 'instinctive activity exerted for purposes of practice or exercise, and without a serious intent,' begs the question. 'Not of serious intent' means play, and that is what he is defining. Practice, being less serious than the thing practiced, easily degenerates into play, but, so becoming less efficient than serious practice, it would not be favored by natural selection. We often see play originating as degenerate practice, as when a company assemble to practice for an exhibition, but this completely spoils the practice. The less playful practice is, the better it is. We surely grant all that can be said for practice, yet much play is recapitulation or embryologic, and reversionary or degenerate or recreative, or it may be wanton. Plays of the degenerate type are gambling, drunkenness, debauchery and similar amusements, and, indeed, all degeneration belongs under play rather than under work. In degenerate activities play freedom is only subjective; there is really bondage. And all play freedom is false and unreal as being mere hereditary impulse, and in so far as the play world is one of unreality and illu-

sion. Rational and real freedom lies in work; the captain of an Atlantic liner has a truer and higher freedom than a boy sailing a mimic craft in a pond. It is easy to idealize play as spontaneous practice, perfectly free, pure and joyous, but at best play is only conservative, and very often is reversionary and even degenerate. Play is a low form of life; and it might be said to be on the whole of more disservice than service, and to be supplanted in the highest evolution of man by work-satisfaction, of which we already see some evidences.

Play, as we have noted, may be described as fresh, free, joyous, spontaneous, impulsive, self-contained activity, whether practice or any other mode. The unseriousness of a practice does not of itself make play, for the unseriousness may be carelessness and laziness, the reverse of play.

To the elements of play we have mentioned are we to add shamming? It might seem that activity which did not contain shamming must be earnest, and so not playful, but earnestness enters into play, and makes it real play. In shamming, the activity is so far unreal, and if playful, doubly so. That is shamming, deceit, guile, is a work form of activity evolved in the struggle of existence, and may, like any other, become play. Shamming play is then merely one definite kind, rather than, as Professor Groos would make it, a phase general to later forms. Much of later play is not mock activity, but a real activity used as a pleasure in itself. The boy driving his ponies is playing as well as the boy who is playing horse by driving his companion or riding a stick, and the man yachting is playing as well as the child sailing chips in a tub. So any activity once fully integrated through work by race or individual may be either played or played at, both modes growing side by side through the whole history of play.

Professor Groos traces æsthetics to shamming play. But the only fine art for which such play could account is realistic portraiture. However, mere *resemblance* is not art. An interest in clever counterfeits of reality for the skillful way they deceive is plainly not the æsthetic feeling for the intrinsic beauty of the thing. Do not 'What a good likeness!' and 'What a beautiful picture!' indicate different mental states? Now the method of development shows the method of origin, and the method of progress in fine art is plainly one of severest toil. Æsthetics must then originate as work-form under natural selection as mode of socialization, specially in sexual relation, and becoming integrated, reappears, like other integrated activities, in play form. Struggle, effort, is the initiating and developing factor in evolution, and how is art an exception by a unique relation to play?

To the artist and art-lover 'art is the most serious and highest work. If art originated in shamming play we should expect the earliest art-plays of children to have this form. But we see children showing a crude æsthetic enjoyment in whistling and drumming, which cannot be accounted deceptive play. Woodpecker music—unnoticed by Professor Groos—is a similar play. So also if animals and children show æsthetic appreciation of bright colors, this cannot be based on deceptiveness. (We have discussed the subject more fully in 'Evolutionary Psychology of Feeling,' Chapter XVII.)

As to classification of plays Professor Groos's scheme is certainly not shown to be a complete and connected natural whole. He omits humor, which ought to be discussed as a possible play with the very highest animals; and scare plays are unnoticed. My dog took the same delight in coming up quietly behind a small dog and giving a terrifying bark as does the child in jumping out from a corner and crying boo! Fighting and hunting plays are hardly to be separated as two distinct kinds. He makes the *rationale* of fighting play among non-predacious animals to be preparation for struggle for the female; but do not also young females fight, and may not such fighting be preparatory to struggle for food and for defense of young? He makes courtship a division of plays, but it is plain that 'calf love' and flirtation are in strict sense the only love plays, that is, playing love and playing at love. Again does not imitative play enter into all kinds of play?

But what we need as a basis of classification is a thorough scientific record and study of the facts. For instance, a continuous study of a dog from birth to death for play and work with photographs and phonograms would be a first step in a science of play, if made by a psychologist familiar with dogs. The records which Professor Groos uses, as made by travellers and naturalists, are mostly incidental observations of slight value. However, it is plain that, since any voluntary activity may be played, the classification of such activities becomes that of plays also. Thus among children even winking and breathing may be used playfully, and we also have finger plays, toe plays, etc. But such an anatomical or physiological classification is little fruitful for psychology. It would see more in such stages as simple play, play and plaything, playing at, player and person played to. As any psychosis may become a play form, a genetic classification of psychoses would apply to plays. Any psychosis well integrated as instinct in the race or as habit in the individual—habit plays are lawyers' jokes among lawyers, etc.—may issue in play. Play is

a peculiar emotion which may invest any action. Play is probably the earliest of the complex emotions. Its distinctness in kind is shown by the fact that we can define it only in terms of itself; when we say an action is playful we have but used the simplest terms, and every one who can play recognizes the peculiar psychosis implied. Play is a generic general phase of emotionalism, which may express itself in the form of any intellectual or feeling mode or of any outward activity.

HIRAM M. STANLEY.

LAKE FOREST, ILL.

THE STRUGGLE FOR A SPIRITUAL CONTENT OF LIFE.[1]

Eucken's latest and most significant work has as yet received no adequate notice in the English or American philosophical magazines. The following is an attempt to give the reader some understanding of the methods and conclusions of this remarkable contribution to the metaphysics of our time.

While the reviewer is, of course, responsible for the general run of the following, he has taken the liberty of paraphrasing the text in numerous places. In this connection it may be well to say that the paper was submitted to Professor Eucken, who advised its publication in its present form.

He who, to-day, raises the question of the meaning of existence and the goal of our activity is caught up not only by the stream of the time, but also by a great flood which springs out of the world's history. The answer to which he is carried is clear and simple. Man belongs to nature—he is a part of her—body and soul. She surrounds us from outside; she rules us from within. She points out to us the only way to truth. When man in his pride and strength turns from nature, his home, and pictures to himself the existence of an independent world of spirit, he has only fallen into error—he has only gone out in search of a fabulous realm. And this vain thought of a spiritual world is only a bar to truth and to happiness. As such it is to be fought and conquered.

With this thought of our time has come a great turning-point in history. Through it there arises the hope of a return to primitive,

[1] Der Kampf um einen geistigen Lebensinhalt; von Rudolf Eucken, Professor in Jena. Veit & Comp., Leipzig. 1896.

elemental truth. Once more humanity shall be revived through closer and more intimate contact with nature.

Into such a relation to nature our time has actually brought us. And this it was able to do just by means of its incomparably sharp distinction between spirit and nature. At first both were one, indistinguishably woven together. The reflection of ancient times and the Middle Ages spun around nature a web of human thought. But this network was to be broken—nature was to be seen in its independence, in its self-existence. Its true being, as distinct from man, was yet to be distinguished, and the soul, as an evil spirit, was to be driven out. This accomplished, nature was seen to be a complex of spiritless masses and motions—all unity was dissolved into small and smallest elements, all worths and ends as mere figments of mind were banished in behalf of a self-sufficient, self-satisfying actuality. For in this vision of nature, so simple and so complete, where is there place for thought? in this vision of world-energy governed by an imminent logic of its own, where is there room for spirit?

As soon as this reduction was accomplished and spirit was driven out of nature, spirit and nature were seen to be two opposing realms. The independence of each was recognized. But nature revolted against this opposition. She turned against man in his isolation and in his alienation. She went out to draw him to her again, to subjugate him. And she succeeded. That she was successful was due to the very power which man had acquired over her by virtue of his alienation from her.

The decay of the vision of the Middle Ages and the rise of an exact natural science was a triumph of man over nature, a subjugation of the external world through human thought. And so, also, the application of technical knowledge and skill. But, again, it was in reality the vanquished which was victorious. For the vision which resulted from the outgoing of man to the external world to overcome it, was so clear and well ordered that it acquired a peculiar power and charm, by virture of which it was carried over to the inner world. Our concepts of the natural became so definite and exact that on their lines was built up our view of the spiritual. The more our knowledge of the exterior world develops, the more are we occupied with it; the more our technical skill increases, the more is life bound up in the machine; the more power man wields over nature, the more she rules his thought, his life and his senses. In this manner man, who believed that he had subjugated nature, was overcome by nature. And thus we find that the opposition between man and nature has been over-

come by our time. It has been dissolved by the rise of our knowledge of nature and by the development of our technical mastery over her. There exists no longer a recognition of the two independent worlds, each existing in and for itself.

But the effect of this dissolution was not the reduction of nature to the inner power by which we came to rule over her, but the opposite. Man has been reduced to nature. He has become in his thought of himself a mere moment in the world processes, an insignificant factor in the varied interplay of phenomena. In the laws which grind out the world he must find his satisfaction; in the hard actuality which opposes him he must see the end of his existence. He falls back again into nature; there is a return to the naïve view of the world in which man and nature are one.

And in this philosophy of our time is there not a certain sublimity? He who would give up his self-existent spiritual world, who would again turn himself out into nature, must be prepared to leave behind many a desire cherished through centuries. But the reward of this self-denial is the falling down of the barriers between humanity and the all.

But sublime as this philosophy is; as deeply rooted in our time as it is; as strongly as the current of world history forces it upon us—we must still raise the question as to whether it can be our philosophy. For if it be true, our ethics and our religion lose their significance; if it be true, a really developing life is no longer possible; if it be true, there is, in short, no spiritual world at all. It is the primal thesis of our work that it is not true. It is the central belief of our author that man has broken through nature—that there exists in and for itself a self-centered spiritual world.

Of the thesis let us at the start make sure. Nature knows of no working from within, no being for itself, no self-activity, no initiative of the thing. Rather every element is bound to its environment, it exists only as a link in an endless chain; all work is the result of stimulus from without and is directed to another. If we men were mere things in nature, time and space would completely dominate; by them we would be forever limited and hemmed in. But the old opinion is false; man transcends time—it is his very nature to rise above the temporal flow. True, we stand in time and seem to be driven about in its stream. But not quite. Were it so, human history would be impossible, for such a history does not arise in a mere flowing by of events. In order that there may be a history man may not merely live his span of years, but he must reach back into the

past; that which is gone must become present; he must unroll the course of time anew. And in doing this we do not merely contemplate the past: we take it up into our life; it becomes a part of our doing; it complements the present. Through history the limitation and contingency of the moment are overcome; through history we conquer time. And so with space.

And thus through history there arises a unity which transcends time and space. This unity is more than a mere summation—it is a welding of the life of the past with the life of the present. But as such it transcends nature. For nature is dominated by time and space. And in nature there is no unity which is not a mere being together—a mere summation. Man as a part of nature is a mere point—like other parts—the mere point of self-preservation. An inner subordination of the one to the whole, the recognition of the right and love of another as products of nature were wonders, compared with which the wonders of the religions pale. From time immemorial the energies of man have endeavored to reduce the source of all action to the mere interest of the individual. But through all time the self-sacrifice of man stands out in protest. What has the overcoming of self to do with the interest of self? Are the heroes and martyrs only sharper Jews than the rest of us? Is not all this a protest against a mere natural ordering of things? In our history and art, in our ethics and religion, in our very penetration of the external world, have we not overcome nature?

These facts of human life are the proof of our thesis. Through them we see the necessity of the existence of an independent world of spirituality over against nature.

But this new reality did not fall as a ripe fruit into the lap of man; it does not surround us as something given. It was fought for through work and experience; it was produced by self-activity; it is the result of a long and fierce struggle. For the mere natural processes could never have produced this spirituality—it must be the result of a free act, a transcending of nature through self-activity.

The first step in the struggle for a spiritual life was the lifting of ourselves above the mere natural environment, a freeing of ourselves from the limitation and narrowness of the immediate, a breaking away from the life which exhausts itself in its effort to preserve itself and to adapt itself to the immediate situation. For in order to have a spiritual world at all we must transcend the *here* and the *now*, we must raise ourselves above the demands of a natural environment.

This step marked the great turning-point in the history of humanity. It brought about something utterly new, something opposed to

the merely natural life. It freed us from nature in that it freed us from the bonds of the immediate and from the littleness of the natural self. For as long as our activity was consumed in a mere adjustment of ourselves to the situation of the moment there could be no freedom, no opportunity for the creative work of spirit. As long as ourselves were mere points, the mere centers of natural instincts, there could arise no spiritual world. The immediateness of life and the punctuality of the selves of that life had to be transcended. For the spirit-world is not a world which rests upon a point. It is a world which rises above all points, which embraces all reality. Thus this spirituality which arose out of nature as a new creation was a sphere which floated above the individual. It was a whole, a unity. For the individual as such could never have conceived it, could never have created it. It was the whole which spiritualized the individual. And the spiritual life wherever it exists is something which is not dependent upon any one self, but something in which the particular self finds its existence. It is always an independent, self-existent whole. And yet this whole was brought about in the creative activity of man. His free act is needed that it come into being. It found its origin in a union of free, creative activity transcending all particularity.

And what is this common activity but *work*?[1] It is the idea of work which marks the great turning-point in life. Through work there arises a new content of life. By means of work we raise ourselves above the limitation and contingency of the natural *here* and *now*. For all work arises out of some transcendent whole; in it a unity to be realized is always presupposed. Work means life-work. At first this unity is the particular unity, a whole to be gotten by the individual. But even so the work of the particular brings about the work of the whole. The particular works are worked into the work of the whole. Reality is the work of works.

As this common reality is the result of work, so is work the result of transcending the immediate *here* and *now*—the product of our struggle to rise above the mediocrity of life, of our strife against the average.

In work we see a new creation, something which cannot be deduced from the spiritless masses and motions of nature. It is a self-centered spirituality, a self-active life, a world resting in the struggle of the whole. As such it hangs over against nature and the punctual self.

And thus, in conclusion, we see that the spiritual life has no exist-

[1] This word is a translation of *Werk* as distinct from *Arbeit*.

ence and no meaning, no strength and no marrow without a rising above the average; that no such transcendence is possible without spiritual self-activity; that there is no self-activity at any one point without a self-activity of the whole, without a universal life, without the opening of a new world.

Man, as it were, hangs between these two worlds—between spirit and nature. Both are real. Of this there can be no doubt.

Nature confronts us at every turn. A large portion of our life is devoted to her. On the other hand, the world of spirit is with us also. To deny its reality is equally absurd. And what is man to do with these confronting realms? Both cannot equally claim him. At the start let us do away with the idea of an empty compromise. Nor can he reduce the spiritual to the natural. This attempt, as seen in the philosophy of our time, amounts simply to a denial of the reality of the spiritual. For centuries the idea of the development of all reality from the pure activity of spirit has exerted a fascinating power over man. But if we follow the links of the chain from Plotinus to Hegel we see that either life became a mere sum of abstractions, or that experience, which at the beginning had been so sharply pushed aside, was unconsciously called in to complete the intuition, to give life to the otherwise empty forms. Nor does the distinction between form and matter aid us. For, on the one hand, the spiritual is far too self-centered and real to stand merely as part of the whole. And on the other, nature is far too cold and capricious when seen in contrast to the spiritual to adapt itself as matter to form.

And yet the dualism is intolerable. The idea of the independent existence of two coördinate but different worlds of reality in life is more than can be borne. The opposition must somehow be overcome. These two masters man cannot serve. And yet neither of them can be denied.

If we would work our way out beyond this dilemma there is but one course for us to take. Both of our worlds are real and yet different. If we are to see them united in life we must see them both as the product of a reality deeper than either.

Here, again, we stand at a great turning-point and once more great possibilities open before us. We must grasp the world as the development of a substantial spirituality, of an essential life. We must see our own free activity as a part of a deeper life. We must see nature as a product of profounder reality.

With the idea of a substantial spirituality, which brings forth a

new and peculiar being out of the depths of activity itself, there opens a new view of our world and our life, an altogether new experience of reality. Both of those worlds, each of which lived in its own right and seemed to pretend to the whole of reality, are seen to be expressions of an essential being. Our free activity must have a deeper life behind itself.

If these two realms are one in their origin, the problem is to realize that unity. It is ours to find in nature this primordial force, this substance; to wrest it from her; to appropriate it to ourselves. It is ours to conquer nature. The act shall take being up into itself; thus it shall itself become real.

This substantial spirituality is not a part of us; we are rather a part of it. Through it we acquire freedom; as a part of it man makes his history; we feel it stirring in us, and we go out to create. But this primordial activity will tolerate no limits; it will not be imprisoned; it will be hemmed in by no barrier. There is nothing in the world which may oppose it; it will brook nothing foreign or alien to itself. Therefore we, as stirred by it, must conquer the exterior world; we must transform it by our spirituality; we must take it up into our own activity. As the artist spiritualizes nature—as he, accomplishing the impossible, transforms it with his own inner life—so must we all overcome the outer world.

It is by this free act that the spiritual acquires character and determination. The inner world, hanging over things as the spirit hung over the waters at the creation, lacks substantiality. As it broke loose from nature and rested in its alienation from her, a certain indeterminateness possessed it. It saw nature as something hostile and foreign. But the spiritual life can acquire substance only as it, through activity, takes nature up into itself—only as it spiritualizes the external through free activity.

The first great struggle of mankind was for the existence of the spiritual. It overcame nature in the battle for a spiritual life. But the life lacked determination, and thus arose a second struggle. It too was a fight against nature; but the end of the struggle was not her destruction, but her spiritualization—it was the strife for the character of the spiritual.

And man, in so far as this world-power rises up in him, becomes world-power himself. Man as a part of nature is driven hither and thither by forces exterior to him; for he is but a mere point, a link in an endless chain. But when he rises up into his primordial activity he thereby becomes world-power. Through him, in him, by him, is

world-history brought forth. Hereby he transcends himself, he rises above the punctuality of life, he becomes a part of the whole, his life moves on in the world life. Thus the individual becomes microcosmus, and the all a world of worlds. When doubt rises up in us, doubt as to God, the world, men and life, it must at last lead back to doubt of ourselves, the doubt as to the ideality of our nature, the presence of a spiritual substance in our life.

In our descriptions up to this point we seem to have traced the triumphal march of spirit, but in reality we have been following only the progress of battle. And this struggle is one which never ends. The strife continues in each plane of life. At first it was the struggle of spirit to raise itself above the chaotic manifold of nature—the struggle for existence; then it was the struggle to lift experience up into spirituality, that the latter might acquire determinateness—the struggle for character; and now we have to see this spirituality enter into a new strife for the world-power of spirit. For as soon as the spiritual life takes on concreteness and character, there arises a host of new contradictions which threaten its destruction, which seem ready to shatter the new life. The powers which seemed to have been conquered spring up again with new force; the old contradictions which seemed to have been transcended appear in new forms. The very forces which worked for good now seem to take on an evil nature. The woe of the world, its contradictions, the thought of death, which seemed to be the kindly spirits of man aiding him on, now turn against him. The whole structure of spirit seems to have been founded on sand and to be on the point of being shattered by the contradictions which have grown up within itself. Doubt as to the reality of the spiritual life arises; we faint in the struggle against the evil; the contradictions seem insurmountable, and we are threatened with the loss of that which we so hardly won and a return to naturalism appears to await us.

The first attack on the new life arises out of our new relations to nature. Here lies the first battle-ground in the struggle for the world-power of the spiritual realm. For the better we have come to know the exterior world, the more foreign it seems to be; the more we have to do with it, the colder and more alien it grows. The forces of nature work in blind objectivity, without respect to the spirituality they hem in and destroy. Fire, water, storm and earthquake annihilate; the little forces of destruction do not sleep. Nature works without respect to high or low, good or bad; she operates without feeling, and

handles the individual, the masterwork of spirit, in perfect indifference.

And as the knowledge of nature grows with the development of spirit, there grows also the knowledge of the utter dependence of the individual on nature. We have long known that the soul is, in general, conditioned upon the body; but we now see in oppressive clearness how every spiritual activity is based upon the corporeal. And then the thoughts of heredity and environment steal in and shed their weird light over the world. And thus man, in his thought of himself, becomes a mere episode in the world-processes. Is it any wonder that he loses faith in the new world—in the spiritual substance?

And so it is with the moral world.

The ethical life has always been the great refuge of man from the bondage of nature. When all else topples and falls the eternal worth of the pure heart and noble mind has stood fast. Here, if nowhere else, man rises above the limitation of nature to the freedom and reality of the spiritual; in this realm, if in no other, the dark despot of the punctual self of nature is overcome. But, even here, the spiritual is threatened by the destroying might of contradiction. After this world has been brought into being, we see for the first time its inconsistencies. For, instead of an all-embracing love and justice, there arises a love and justice bounded and limited by the instincts and passions of the self of nature. Our morality is well and good only so long as it favors ourselves, our party, our narrow circle or our race. And thus the object of the moral world is a manifold of scattered units instead of the totality of humanity—a collection of little centers separated by a wide gulf, instead of the whole of mankind. Here we see, in all clearness, the triumph of evil, the unconquerable nature of sin, bound up as it is in all our spiritual activities. So we doubt the reality of our ethical life.

And we fare no better when we turn to history, for here we find the past to be only a great mass of actions done and gone. We are unable to draw from it the fresh, active present for which we had hoped. History should solve our problems for us—in the past of human life should be seen a line of steady development making for eternal truth. But instead of that, we find only a nexus of contradictory intuitions and faiths. History should have solved our problems, but instead of that it has travailed only to bring problems forth. And we lose our faith in the past of human experience.

And so is it also when we consider the nature of society, fate and the very spiritual power itself.

The evil does not lie on the surface; it reaches down into the fundamental conditions of our very existence. The spirituality which does appear seems too weak to overcome the great attacks which are made upon it unceasingly. In its own development it constitutes rather an indifferent form to a content than a full world. History has rather increased than diminished the complications. The new world has been brought forth, but only cracked and broken by fundamental contradictions. Once more we find ourselves in a great dilemma—again we have reached a position where we must either turn back or go on still further. No compromise is possible; to stand still is intolerable; some solution to the problem of our relation to the evil in the world must be found.

The history of world-thought contains many attempts to escape this dilemma; indeed, it has been largely occupied in endeavoring to offer some solution to the problem. There have been in general two great answers to the question. According to the first of these, the evil in the world is mere appearance, the good alone is real; according to the second, the evil alone is real, the good is mere appearance. The former is optimism; the latter, pessimism. Each comes to its conclusion by denying the reality of one side of the dilemma.

The first great plea of optimism lies in the thought that if we could but see the world from its center the evil would disappear. The bad is in the last analysis good, for through the bad the good rises up and grows. The second plea lies in the thought that if we would but do the good the evil would cease to exist for us—if we would but center our lives in the world of the pure and high the world of the impure and low would be forced into non-existence. But whether the optimism be that of consideration or of action, its falsity remains. For, no matter what our point of view may be, no matter how our actions may be directed, evil remains and must ever remain. It were as easy to prove that the good serves the evil as the evil the good. If we must write our theodicies why not also our satanodicies?

The essence of pessimism lies first in the thought that the world down to its very center is evil, and second in the act of giving up the hope of attaining the good or the true. The theoretical view of the world as bad and truth as an illusion must end practically in the giving up of the good and the true—the philosophy of evil must inevitably result in the philosophy of self-denial.

But if there be neither happiness, virtue nor truth in the world, what have we to give up? If the idea of the good be an illusion,

what is the meaning of self-denial? The very fact that the turning away from happiness costs us so much effort and gives us so much inspiration is *prima facie* proof of the existence of happiness. And so with truth and goodness. Truth and goodness remain in all their sublimity; pessimism is but the turning away from them.

Pessimism and optimism may annihilate each other in their struggle for supremacy; but the good remains good, evil does not cease to be evil, and both are real. And the moralist still moralizes on the 'mixed character of human life.' Truly life is mixed, not merely on its surface, but in its very depths. And after all the dilemma still remains unsolved and still demands solution. But if there be any power and courage left in life there is one way of escape open—we can transcend the sphere of conflict, we can raise ourselves above the contradictions into a new realm. The world of struggle is not the only world; its barriers shall not block our progress. There opens a sphere of activity beyond the sphere of these contradictions; in it must we center our life.

This new order would appear as something transcendental, something which lies beyond the horizon of our world. But in truth it should only expand the real; it should command for itself the first place in our world and force all else into a subordinate position; but still it should be within the real, our real. The ultimate and final it must always be; it must contain all absolute truth; in it must be builded the world-power. As such and as such alone can it transcend all contradiction and overcome all opposition.

This is a hard saying—this last step in our spiritual life is the most difficult of all to grasp in thought and to realize in action. But the saying nevertheless is true. And that it is such we can see, if we can see at all, from the workings of religion. For this struggle and this realm are essentially the struggle and the realm of religion.

In religion the individual rises out of the contradictions of the world. He does this because he lays hold of the absolute life. The contradictions of the world do not disappear; they are rather intensified; but in that something absolute is realized, they are transcended. The barriers are not broken down; we leap over them. For in religion we leave this world of struggle behind, we rise up into a realm of absolute truth which knows no contradictions—the spirit reaches the plane in which it becomes the world-power. For the struggle to reach an ultimate point and to bind all life to it is essentially the struggle of religion.

But this new life is not an abstraction—it is a personal activity, a

coming into relation to the absolute life. It is not something given, but something to be gotten by a free and original act. It is to be gotten because all that confounded us in the lower life is overcome in something higher.

If this new and final realm is to be seen from the standpoint of religion, it is now clear that the rest of spirituality is to be seen from the standpoint of culture. First of all we have a struggle for the creation and preservation of the spiritual in general; then the struggle to penetrate and overcome nature, and finally the struggle to rise to an ultimate reality beyond the contradictions of the former stages. The second of these steps belongs essentially to the world of culture, the third to that of religion. And these two worlds must ever remain distinct and separate spiritual experiences. They have often striven with each other; each has claimed its sole right to exist, but mankind ever returns to them both. Neither can be omitted from the great system of the spiritual.

In conclusion we may sum up the foregoing as follows:

We saw the world of the real open itself in three levels.

The first problem was that of the independence of the spiritual life. This life cannot exist as a mere expression of a foreign activity. It must be self-centered. That it arises in its purity was due to a breaking away from turmoil and particularity of nature and the formation of a new and peculiar realm of ideal worths. With the development of the independence of the spiritual there arose not a world of particulars which left alone the rest of reality, but the soul of the real itself. Through it came about a turning of being to its own truth, a finding of itself, a delving into the depth of life. As such it is more than a mere human phenomenon. Mankind is thereby taken up into world movements which raise man above particular powers and interests; which raise him above the mere average of life.

But necessary as this step was, by means of it alone the spritual attained only general outlines. A second step was required to secure it character. This was taken in order that the great opposition between the spiritual and non-spiritual external world be overcome. Thus, there took place a return of the spiritual to mere existence. Nature was grasped from the standpoint of the new life in order to spiritualize her. But this struggle could not meet with success without transcending of the work of the mere individual and the formation of a unity of spiritual life. Thus there arose a life-system, a totality of work, a spiritual substance, a struggle for

the character of life. And thus the happy end of life and satisfaction with the real seemed near at hand. But the struggle with the content of our human experience developed unforeseen but fundamental contradictions. The new life was seen to be rent with irreconcilable oppositions, the actuality with which it had to deal, cold and indifferent. All attempts to reconcile or wipe out proved failures; the whole was lost but for the opening of a new world, the rising of spirit to a new level.

Thus a third step was undertaken, and there came about a struggle for the world-power of spirit. Life was raised above the contradictions; it was united to the absolute life.

But in so doing the old world was not to be given up. Its levels were to be preserved in their distinction and integrity. In the relation of each to the life process was to be found the consummation of spirituality.

From beginning to end this spirituality was to be conceived as a noologic reality, something not based on the *psyche*, but on the *nous*. It is a coming to itself of reality, being turning to its own truth.

We may not start with the world or with the soul, but with a life which is over and beyond these; which does not belong to man, but of which man may become a part.

FRANCIS KENNEDY.

UNIVERSITY OF COLORADO.

EXPERIENCE UNDER THE INFLUENCE OF ETHER.[1]

I have called this a description of my experience under the influence of ether, although chloroform was used for a few moments at the start, producing no noticeable effect, however, except a taste of sweetness. The ether had a decidedly disagreeable taste.

After about two minutes the larger muscles of the leg began to be affected, those of the calf first, closely followed by those of the upper leg. The feeling was that of tiredness, with a prickling sensation somewhat like that felt as the blood begins to course after one's limb has been 'asleep,' somewhat like that felt in an electric bath, but not exactly like either. The ends of the nerves seemed to vibrate, as it were, and I imagined the nerves contracting in length.[2]

[1] An experience of I. B. communicated by Professor E. A. Kirkpatrick; suggested by the communication from Professor W. James, in the May number of the REVIEW.

[2] I have always had a nervous feeling similar to this when hearing of one's passing through excessive pain, and can quite readily reproduce it since my experience with ether.

These sensations were soon followed by a feeling of inability to get breath, like that produced by the pressure upon the chest of a bather who is not accustomed to the water. The muscles of exhalation, however, did not seem to be much affected. Later there was a slight sense of suffocation, but I do not remember that breathing became at any time very laborious.

The next muscles to be affected were those of the arms, the biceps first. The sensations produced were much like those in the legs, but milder.

By this time the prickling sensations in the leg muscles had been gradually replaced by a weariness that was almost unendurable. Every muscle seemed to be utterly exhausted. I would seek temporary relief by crossing and recrossing the legs, until they finally became so heavy and numb that I could not move them. I do not remember any muscular relaxation, nor any internal feelings, as of the heart or stomach.

The last sensation I remember was that of my weight upon the stretcher. I have no remembrance of the time when the smaller muscles became affected, nor of the bodily feelings just before entire insensibility came on; it seemed to come upon all parts of the body at once.

Following bodily insensibility began a horrible mental struggle even more indescribable than the bodily sufferings. It was a life-and-death struggle between existence and non-existence. I seemed to see myself as in a dream, a space of light about four or five inches in diameter. Surrounding this space was non-existence, a thick, heavy, material darkness, which steadily encroached upon the limits of the light. The awful part of it was that I seemed bound to resist to the last possible moment and yet realized that darkness must finally triumph. I had no sense of having or wishing weapons to use in the struggle with darkness, nor any remembrance of ever having had bodily members.

For a short time there remained the idea, somewhat comforting, that I should sometime awake from my condition and be free again. Nearly to the last I retained an indistinct visual memory, and I saw myself going through some former activities. The last thought I remember was: 'Thou alone art able; so, Lord, watch over me.'

This mental struggle seemed to last some ten to thirty minutes; for the most of which period of existence, this luminous space seemed to be in the form of a funnel, and gradually to decrease in size until it became a point of light, which vanished in about the direction of the North Star. The struggle seemed to begin in an enclosure about

the size of my head. This enlarged in all directions until its limits became infinite.[1]

On awakening,[2] my desire was to blow; at first my efforts were very feeble. I desired principally to blow the doctor out of existence. I was in a general fighting state of mind, and as I went out upon the street desired to shake my fist at show-bills and people, but refrained for fear I should be thought crazy. It took a day or more for this effect of the ether fully to wear off. The ether made me quite sick for nearly a week, and for several years afterward the smell or mention of it produced a feeling of dread.

I. B.

[1] I have several times had this experience in the partial delirium of fever; with this difference, however, that in fever the sensation is a painful one, the room in which I imagine myself enlarging until the thought of it gives pain; often, too, this enormous space will seem painfully empty, with perhaps two or three voices in different parts or enormous animals tramping about.

[2] My attendant informed me that while coming out of the sleep I would raise one leg, then the other, striking my heels heavily on the couch.

PSYCHOLOGICAL LITERATURE.

The Groundwork of Science. A Study of Epistemology. St. George Mivart. The Science Series. New York, G. P. Putnam's Sons; London, Bliss, Sands & Co. Pp. xviii+328.

The term science is used in this work with an ambiguous meaning. At times the author employs it in the general etymological sense to cover all forms of systematic knowledge and inquiry. For the most part, however, he means by it the empirical sciences, divided into two classes, those which relate to the physical world and those which have to do with the inner, psychical life. The aim of the work is to investigate the principles which lie at the basis of 'science;' and so the inquiry becomes an essay in general epistemology, with particular reference throughout to the noëtics of science in its more narrow and technical significance.

The psychological foundation of Professor Mivart's theory of knowledge is a sharp distinction between the lower and higher faculties of knowledge. The former belongs to animals as well as man, and the harmonious working of its several subordinate processes ('consentience') enables the brute to manifest phenomena which resemble the results of man's higher psychical activities without in the least being the same as these. The human infant, it is true, in many respects is not unlike the animal, but the likeness is superficial, since, in reality, there is a great gulf fixed between the two orders of consciousness. Latent in the mind of the child lie the germs of his future thought; but the animal is limited to his lower level, with no hope of future development. Moreover, those who maintain that the higher faculty in man has been reached by a process of natural selection are in error; for natural selection has no power in itself to bridge a gap 'in kind,' and the truths which are attained by means of the faculty in question are in the great majority of cases such as 'never could have given their possessors an improved chance of survival' (pp. xiii., 272 ff.).

This higher faculty of knowledge is described in a variety of ways. It is 'intellectual,' in distinction from sensuous, 'perception;' it is the source of 'intellectual conceptions;' it is intellectual intuition; it is

reflex self-consciousness; it is the power of cognizing relations; above all, or rather in all, it is the source whence we derive the primary and self-evident principles which form the ultimate premises of all ratiocination and without the support of which science, like knowledge of every kind, becomes an impossible dream. As these original intuitions are considered by Professor Mivart the foundation of all thinking, he is careful to repeat his summary of them at various points in his work. The briefest statement of the list is as follows:

"The existence of certainty; the existence of an external world; our continuous substantial existence; the validity of the process of inference; the self-evidence of some truths; the principle of contradiction; the evidence of axioms; the principle of causation; the uniformity of nature; and the existence of necessity and contingency" (p. 310).

Chief among these, at least in the amount of energy expended in its defense, is the second, which is stated more in detail on page 106: "An external, objective world exists and is truly apprehended by some of our intellectual acts, an absolutely certain knowledge of objectivity being afforded us through memory, which reveals to us real existence external to all our present experience." The entire third chapter of the book is devoted, in the spirit of this principle, to the refutation of idealism. The argument is vehement and decided, although it is not till a later stage in the inquiry that the Berkeleyan is classed with the insane, for the author believes that physical science is possible for those who accept idealistic views only because a beneficent nature has endowed them with faculties that guide them aright in spite of their speculative vagaries. Nevertheless, it would be difficult to maintain that Professor Mivart's discussion furnishes many new weapons with which to repel the idealistic attack. In fact, it is doubtful whether he clearly distinguishes between empirical idealism and metaphysical idealism; and it is certain that, confident in the *a priori* arguments, he fails to avail himself of the realistic implications with which modern physical science abounds.

In the last two chapters of the work we come in sight of a theistic capstone for the epistemological edifice; while the last of all, with the same title as the whole book, brings a short consideration of the metaphysics of science (force, energy, time, space, etc., p. 297 ff.).

The type of philosophy thus presented is so familiar that no extended critique is demanded. The way in which it is presented, however, calls for rather more attention. The following quotation may serve as an example of the care with which the argument is conducted,

for it is scarcely to be credited that it is a fair specimen of the author's philosophical erudition:

"For the whole of the philosophy of Germany and Holland, from Spinoza to Hartmann, has been a result of the mental seed first sown in men's minds by Berkeley, who explicitly produced what was implicitly contained in Locke" (pp. 40–41).

Here are two examples of accuracy in reasoning about the subtlest epistemological questions:

"Though we are for the most part content to act on reasonable probabilities, yet certainty attends us at every turn. * * * If we find, on returning to our library, that a window which we had carefully closed before starting, is open, we are quite sure that some one must have opened it" (p. 98).

"The first and most important of these" [self-evident] "principles is the perception of the reality of existence—that which we perceive to exist evidently does in truth so exist. This is often expressed by the formula '*A* is *A*' * * * *" (p. 242).

Finally, we may cite one or two instances of philosophical humor such as rarely lighten the labors of the epistemological student:

"To the other idealistic extreme, that by Hume, we will sacrifice no space, for, in spite of its author's acuteness and great ability, it does not really admit of logical statement, so utterly incoherent is it, and so confident are we that its ingenious author had no belief in it himself, but was laughing in his sleeve at his inept admirers and disciples" (p. 83).

And this, in criticism of Mr. Spencer's assertion of our anthropomorphic interpretation of physical causation:

"Surely greater nonsense has rarely been written. Let us suppose the partly-sawn-through tree to be not even touched by us, but that a gale has sprung up which, after having swayed it to and fro, breaks it off and prostrates it, just as we have supposed it prostrated by human efforts. Are we not then to say that the wind has exerted as much force as was ours? Can we not say this confidently, without being such idiots as to attribute 'feelings' to the wind?" (p. 261).

These, it is true, are among the most striking illustrations of the style of the work. But they are not isolated cases. And, in spite of the learning and insight which are evidenced in this as well as in the other products of this well-known author's pen, it is to be regretted that the philosophical volume in a scientific series should itself be so unscientific in character.

A. C. Armstrong, Jr.

Wesleyan University.

L'Art et le Réel; Essai de Métaphysik fondée sur l'Esthétique. Par JEAN PÉRÈS. Paris, Felix Alcan. 1898.

An attempt at developing the metaphysical implications of the æsthetic sentiment, this work, though lacking somewhat of the systematic character of the masters (of a Schelling, for instance, under whose influence, by the way, much of it seems to be conceived), is yet true to the French traditions of good style and does justice to the more important æsthetic and sociological intuitions of the time.

Though mainly of metaphysical interest, it is full of keen psychological analyses, especially of the sentiments of the beautiful and the real, upon the identity of which (as seen in the analysis) a striking argument for a monistic doctrine of experience and existence is built. The advantage of going out from the æsthetic side of experience, in a metaphysical reconstruction of the real, lies in the fact that art is double-faced, on the one side historical reality, and on the other, as embodying the sentiment of beauty, it implies nature. Transcending alike the abstract dualism of subject and object, which abstract thinking entails, and the dualism which volition discovers between the self and the world, sentiment alone can attain the absolute unity of intuition. The method of this metaphysical analysis of sentiment is not, therefore, the abstract analysis of psychology—its beauty is not the beauty of psychology, nor its real the real of science. It is the difference between concept and sentiment. Now the sentiment of reality, as distinguished from the notion of the real, is possible only when the *habitual* of intellection or volition is transcended, for the conceptual is the sphere of the possible; the individual volitional, from the standpoint of immediate experience, is the sphere of chance. The sentiment of the real is always an intuition of universality, of destiny, brought about by the 'choc' of a novel experience. This sentiment of the real in contrast to the notion of the real has in it the inherent power of grasping subject and object, nature and soul in a higher unity, and is characterized as '*une vivante analyse du réel*,' called forth by states of high action and intense nervous energy. An analysis of the æsthetic sentiment shows it to be of the same character, in so much that the author calls it the culmination of the sentiment of the real. The highest form of the love of existence is the love of beauty.

The concept of life, therefore, as a primal activity expressing itself in its highest potencies in the sentiment of the beautiful real, is fundamental; "il semble in effet que l'homme embrasse le réel par la connaissance et la contemplation de toute l'ardeur de toute l'intensité

du sentiment par lequelle il comprend ce qui lui manque pour être ce qui est."

Upon this basis the book proceeds to show in detail the manner in which art has been a progressive realization of elementary forces of life by means of the emotions of reality which it affords. The chapters upon the æstheticising of the categories of space and time, of unity and infinity, upon the social necessity of reflection upon the real, and the essentially æsthetic qualities of the past as compared with the present and future are interesting, both as developments of M. Pérès' doctrine, and also as specimens of fine metaphysical analysis.

In conclusion we may call attention again to the originality of these analyses of the sentiments of the Real and the Beautiful.

WILBUR MARSHALL URBAN.

URSINUS COLLEGE.

Studies of Good and Evil. JOSIAH ROYCE. New York, D. Appleton & Co. 1898. Pp. xv+384.

In this collection of essays Professor Royce has presented the principles of his idealistic philosophy in their application to the problems of life. They show the author at his best in the sphere of concrete thought. His idealism is here essentially a philosophy of reality. He touches upon various themes, most of which bear upon the ethical aspects of life. His topics range from the problem of Job to modern character studies in the essays on *Meister Eckhart* and *Jean Marie Guyau* and such social problems as are suggested by *The Squatter Riot of 1850 in Sacramento.* The several essays on consciousness and also the one entitled *The Case of John Bunyan*, must prove of special interest to the student of psychology; those who are interested especially in the mental experiences of the abnormal type will appreciate Professor Royce's exhaustive analysis of Bunyan's religious experience.

JOHN GRIER HIBBEN.

The Conception of God. A Philosophical Discussion Concerning the Nature of the Divine Idea as a Demonstrable Reality. By JOSIAH ROYCE, JOSEPH LE CONTE, G. H. HOWISON and SIDNEY EDWARD MEZES. New York, The Macmillan Co. 1897. Pp. xxxviii +354. Price, $1.75.

These papers were originally presented in a discussion concerning the being of God which was held under the auspices of the Philosophical Union of the University of California. To the main discussion there is added a supplementary essay by Professor Royce outlining

his position more in detail. The main argument is by Professor Royce, and is unfolded with his usual skill and dialectic subtlety. In the implications of our ignorance he finds the intimation of an absolute knowledge, and in the attribute of omniscience he discovers the germinal concept of God, insisting, however, that absolute knowledge also implies love, will, wisdom and the other divine attributes. His position of monistic idealism is combated by Professor Howison, who urges the impossibility of reconciling an immanent God with the free activity of individuals. Professor Royce, in rebuttal, discusses at length the principle of individuation which according to his view lies in that exclusive interest which is characteristic of the individual will. He, therefore, very stoutly maintains that the unity of the world in terms of self-consciousness does not destroy individuality as Professor Howison would insist, but, on the contrary, while transcending the category of individuality, the unity of consciousness need not, however, sunder the individuals which are embraced in it.

Professor Mezes' main criticism of Professor Royce's argument is that the concept of God as given by Professor Royce seems to lack the elements of spirituality. In defense, however, it is urged that the idea of spirituality, so far as it is a valid idea, must be one of the ideas which the Absolute finds fulfilled in his experience. In other words, Professor Royce contends that the idea of spirituality is implied in his concept of God, inasmuch as an absolute knowledge and experience must be an absolute knowledge and experience of the spiritual as well as of the purely intellectual elements of consciousness.

Professor Le Conte in this discussion urges that the concept of God is illumined by a true interpretation of the phenomena of evolution. He finds in the process of evolution a real progress from what he designates a diffused form of Divine Energy to a personal form. Professor Royce does not seem, however, to be in sympathy with Professor Le Conte's metaphysical interpretation of the theory of natural evolution, and insists, moreover, that along such lines of thought very little progress will be made towards a solution of the vexed problems of evil, of immortality, or of freedom.

This discussion is of special significance inasmuch as it has not been a mere clashing of conflicting opinions, but, on the contrary, the several participants seem to agree substantially "in recognizing," as Professor Howison himself remarks, "in some form or other an organic correlation among the three main objects common to philosophy and religion—God, Freedom, Immortality."

JOHN GRIER HIBBEN.

PRINCETON UNIVERSITY.

The Problems of Philosophy. By JOHN GRIER HIBBEN. New York, Charles Scribner's Sons. 1898. Pp. 203.

Professor Hibben has undertaken an important service for philosophy in this country. It may be a little querulous to ask why not write a philosophy itself instead of a mere description of its problems. It is a philosophy that we need much more than a propædeutic to its problems. But there is a good excuse for doing the latter, and it is that no one will permit another to make the undertaking with any peace. There is too little belief in its possibility for any one to have the necessary courage. But it is permissible to state what the insoluble problems are. Professor Hibben thus labors under a disadvantage in the restraints which a philosophical public imposes upon him, and I judge from some observations in his book that he would be glad to be free from them. But the task, whether grateful or ungrateful, has been done in a very clear and concise manner. In mapping out the lines of thought for the student the book will be found to have performed an excellent service. I would criticise only the introductory chapter, as too much of an attempt to purloin an interest for the subject from the field of literary ideals. Philosophy has taken on the severer aspect of science, and does not well tolerate an appeal to sentiment. The other portions of the book, however, sustain a different tone, and ought to accomplish the object for which it was written.

J. H. HYSLOP.

COLUMBIA UNIVERSITY.

INDIVIDUAL PSYCHOLOGY.

I 'testi mentali' per l'esame degli alienati. Note di psicopatologia individuale dei dottori G. GUICCIARDI e G. C. FERRARI. Reggio-Emilia, Calderini. 1896. (Riv. Sperim. di Freniat., 1896, XXII.) Pp. 20.

Di alcune associazioni verbali. Ricerche di psicologia individuale dei dottori G. GUICCIARDI e G. C. FERRARI. Reggio-Emilia, Calderini. 1897. (Riv. Sperim. di Freniat., 1897, XXIII.) Pp. 26.

Il lettore del pensiero 'John Dalton.' Contributo allo psicologia delle piccole percezioni e dei movimenti minimi. G. GUICCIARDI e G. C. FERRARI. Reggio-Emilia, Calderini. 1898. (Riv. Sperim. di Freniat., XXIV.) Pp. 56.

In the first paper the authors describe a series of tests used in the psychological laboratory of the Psychiatrical Institute at Reggio for

determining the higher mental powers of patients. The tests were of five classes: (1) *Motor phenomena.* As a study of more or less unconscious movements the subjects were told to write a set of 20 figures, dictated at a uniform rate, then a similar set dictated at an irregular rate, and finally to perform a simple operation in division. The graphical errors, repetitions, delays, etc., which varied greatly among different patients, were taken as measures of individual and type differences. To test the conscious control of movements the Charrière apparatus was employed. (2) *Vaso-motor phenomena and emotional states.* The sphygmograph was used while the patient was asked various questions, some of which he could answer, others not. The record indicated the patient's emotional excitability. (3) *Field of apperception and attention.* In a dark room a number of stimuli were simultaneously illuminated by a spark from a Holtz machine; the stimuli used in different tests were figures, capital letters in chance order, the same forming a word, and letters of different colors in chance order. The object was to determine the number of stimuli recognized in each case. (4) *Reasoning, æsthetic emotion and association.* Reproductions (uncolored) of celebrated pictures, simple in motive, such as the Angelus, were shown; also a series of eighteen photographs representing a celebrated French actor in various guises. The subjects were to tell what each represented or sugggested. (5) *Organic memory; sense of time and space.* A dial was arranged with a hand moving in one direction, slowly and uniformly. This hand was first made to move over a determined space on the dial; the subject was then blindfolded and told to make the hand cover the same space, starting and stopping it by an electric key.

The authors report typical results obtained from the patients for each test, which they compare with results obtained on normal individuals. They do not attempt, however, to tabulate the entire series. The third and fourth tests are mentioned as giving especially interesting results, which differ greatly from the normal. In connection with the fifth test, the authors note the distinction between spatial and temporal types of individual, as well as a neutral type, the latter measuring the rate equally well by either datum.

The second paper describes experiments performed on 54 normal persons—30 men and 24 women. Each subject was tested separately. A paper was given him, on which were written the five combinations *ile*, *eno*, *ago*, *ondo* and *olle*, and he was asked to set down as many words ending in each of these as he could think of in ten minutes. The experimenters noted the order in which the words were set down.

with special reference to the skipping about from one ending to another; they also noted the number set down during each successive minute. From the tables given we find that the men's average was much greater than the women's (39.2, as compared with 27.5); that of persons 30 years of age or over greater than of those under 30 (for the men 41.8, as compared with 33.6), and the average number found during the first five minutes from two to three times greater for every class of individuals than during the last five minutes. A difference was observed in the procedure of men and women; the former generally endeavored to think of a number of words with one ending before passing to another; the latter usually attempted to find one word under each head successively. The curve representing the number found each minute falls steadily for both men and women, except during the seventh minute, when it makes a decided rise.

There are, unfortunately, several serious numerical errors in the tables published—notably the division (three times!) in Table I. by 39, instead of 30, the number of males. These and other errors throw doubt on the reckoning generally and tend to impair the value of the conclusions.

In the third paper the authors describe their experiments on the 'thought reader' John Dalton—who is, by the way, a great-nephew of the discoverer of Daltonism. Dalton lays no claim to any occult powers, but simply to unusual acuteness of perception for small muscular indications and other minute forms of expression. He submitted himself willingly to all the tests, and seemed eager to assist as far as possible in elucidating the phenomena in question.

Cranial measurement showed nothing noteworthy. The visual field was normal; the visual acuteness slightly below the normal. A number of mental tests made were similar to those described above in the first paper. In the test of spatio-temporal memory Dalton proved to be of the purely spatial type. The test of the apperceptive field, with letters illuminated by a spark, showed him to be rather above the normal. With the Charrière apparatus for testing motor ability he proved to be extraordinarily expert in both hands. A series of memory tests with numbers, colors, etc., indicated a high degree of development of the memory. The reaction times on sight, hearing and touch were rather large. The association test showed a decided preponderance of visual images, with a large number of ideational associations; purely verbal associations and images from other senses were few in number. The subject was asked to describe, blindfolded, the nature of objects placed in his hand; the results showed great acuteness of tactual perception.

One of Dalton's professional 'specialties' is the designation of an object chosen among a set and thought of earnestly by the 'willer,' whose thoughts he 'reads.' He accomplishes this both with and without direct contact with the 'willer.' In the case of direct contact the minute muscular expressions of the 'willer' furnish the general clue, but here, as in the case without direct contact, he declares that the ultimate indications are furnished by the latter's breathing. Tests of this were made at the laboratory, with and without contact, a pneumograph being used to record the 'willer's' breathing. Dalton picked out the required object at once, but purposely passed it over two or three times before finally indicating it. The breathing curve showed a marked change whenever he approached the object. The muscular indications proper were of course not open to direct experiment. Dalton asserts that they enable him to discover at once whether the subject is good or not. These indications are not always of the same sort; some subjects give 'guiding,' some 'opposing' indications; both classes of hints, however, are favorable. It is only when a subject, through lack of attention, fails to give any indications at all, or through nervousness makes various movements besides those due to the object in question, that he is unable to succeed. The indications he interprets are minute in character, and must not be confused with the more apparent muscular movements which the unpracticed observer might regard as indications.

In the latter part of the paper the authors discuss at some length the history and theory of 'thought reading.' Three distinct theories have been advanced to account for the phenomenon: (1) The direct passage of something from brain to brain—the spiritualistic interpretation. (2) The transmission of nervous force from brain to brain by some *dynamic* process not yet understood—by a sort of induction, or by some species of transformation of energy. (3) The transmission is only apparent; it is really due to minute and unconscious expressions on the one hand and an abnormally acute perception on the other. The present tests, corroborating Dalton's own statements, indicate that the third explanation will cover all cases where the 'thought reader' and his subject are in close proximity. In accordance with this view the authors ascribe the power to a partial dissociation of subconscious personality, which gives rise to a species of partial automatism. They believe that the study of telepathic phenomena proper must start from this point and work up, proceeding by means of psychological experimentation, and using, as far as possible, psychological laws already established.

HOWARD C. WARREN.

PRINCETON UNIVERSITY.

VISION.

Untersuchungen zur Pathologie der Pupillenweite und der centripetalen Pupillarfasern. O. SCHIRMER. Graefe's Archiv, Bd. 44, pp. 358–404.

Disturbances in the pupillar reflex may be due as well to anomalies in the centripetal part of the reflex circuit as in the centrifugal, but almost no instances of such anomalies are to be found in the books, for the very simple reason that they are extremely difficult to diagnosticate. The subject has, however, acquired great interest since it has been affirmed by v. Gudden, and independently by Bechterew, that there are special centripetal fibres in the optic nerve for the regulation of the width of the pupil. These fibres are thicker than the visual fibres; they cross, in half, in the chiasma, like them; they run by the side of the visual fibres from the same point of the retina, and they leave the visual fibres only in the region of the external geniculate body. v. Gudden found in rabbits that the removal of one of the corpora quadrigemina produced contralateral blindness without affecting the movements of the pupil; only after portions of the thalamus were also disturbed did the pupil of the blind eye also remain widened. Schirmer has been able, by an admirable series of observations on the human eye, to make the following additions to our knowledge of this subject. The pupillar fibres of the optic nerve do not reach so far as the layer of rods and cones, but they start in an earlier layer of the retina; their terminal organs are in all probability the amacrine cells. The macula and its region is abundantly supplied with pupillar fibres, but they are not wanting in the periphery; they are sufficiently numerous there to keep the pupil more contracted than in the case of the cutting of the optic nerve. The pupillar fibres resist mechanical compression much better than the visual fibres do, but they are equally subject to inflammatory processes, and hence the width of the pupil may become an aid to diagnosis.

C. LADD FRANKLIN.

BALTIMORE.

NEW BOOKS.

Beiträge zur Akustik und Musikwissenschaft. Herausg. von C. STUMPF. 2 Heft. Leipzig, Barth. 1898. Pp. 170.

Essai d'une Philosophie nouvelle suggérée par la Science. L. RIBERT. Paris, Alcan. 1897. Pp. 562. Fr. 6.

System der Werttheorie. CHR. v. EHRENFELS. Leipzig, Reisland. 1897–8. Bd. 1, pp. 277. Bd. 2, pp. 270.

Spirit Slate-Writing and Kindred Phenomena. W. E. ROBINSON. New York, Munn & Co. 1898. Pp. 155. $1.

Destinée de l'homme. C. PIATT. Paris, Alcan. 1898. Pp. 244. Fr. 5.

Les Origines de la Psychologie contemporaine. D. MERCIER. Louvain, Institut Supér. de Philosophie. 1897. Pp. 686. Fr. 5.

The Psychology of Peoples. G. LE BON. New York, The Macmillan Co. 1898. Pp. xii+236. $1.50.

La Famille dans les différents Sociétés. C. N. STARKE. Paris, Giard et Brière. 1898. Pp. 278. Fr. 5 and 7.

Sammlung der Abhandlungen aus Pädagogische Psychologie. Bd. II., H. 1. *Arbeitshygiene der Schule.* F. KEMSIES. Pp. 64. Bd. II., H. 2. *Psychologische Analyse der Thatsache der Selbsterziehung.* G. CORDES. Pp. 54. Berlin, Reuther u. Reichard. 1898.

Instinct and Reason. H. R. MARSHALL. New York and London. 1898. Pp. xiii+574. $3.50.

Aperçus de Taxinomie générale. J. P. DURAND (de Gros). Paris, Alcan. 1899. Pp. 265. Fr. 5.

Psychophysiologische Erkenntnistheorie. TH. ZIEHEN. Jena, Fischer. 1898. Pp. 105.

Le libre arbitre. ERNEST NAVILLE. 2me éd. Paris, Alcan; Bâle et Genève, Georg. 1898. Pp. xiv+311. Fr. 5.

The Doctrine of Energy. B. L. L. London, Kegan Paul. 1898. Pp. x+108.

Année biologique. YVES DELAGE. 2me année, 1896. Paris, Reinwald. 1898. Pp. xxxv+808. Fr. 20.

Report of the Commissioner of Education for the Year ending 1896–7. W. T. HARRIS. Vol. I. Washington, Government Printing Office. 1898. Pp. vii+1136.

Contains a section devoted to the recent literature of imitation made up of articles by Miss A. Tolman Smith, W. T. Harris (Chairman), and E. H. Russell.

Psychologie der Veränderungsauffassung. L. William Stern. Breslau, Preuss & Jünger. 1898. Pp. xiii + 264.

L'Éducation des Sentiments. P. F. Thomas. Paris, Alcan. 1899. Pp. 287. Fr. 5.

Truth and Error, or the Science of Intellection. J. W. Powell. Chicago, Open Court Co. 1898. Pp. 428. $1.75.

NOTES.

The Macmillan Co. announce the early appearance of an English translation of M. Tarde's *Les Lois Sociales*, by Professor H. C. Warren, of Princeton. We reserve our notice of this important and timely *résumé* of M. Tarde's larger works until the translation appears.

In accordance with the request of the Government of Venezuela and of the Committee on Organization, the III Pan-American Medical Congress is postponed to meet in Caracas in December, 1900.

The prospectus has been issued of 'An American Journal of Anthropology' (name not yet decided), conducted by an editorial board of well-known anthropologists with F. W. Hodge as secretary and managing editor. The journal is to be the organ of Section H of the A. A. A. S., and it will replace the *American Anthropologist*. Advance subscriptions should be sent to Dr. Franz Boas, Columbia University, New York. Quarterly, $4.

We have received also the prospectus of the *Zeitschrift für Pädagogische Psychologie*, to be issued first in January, 1899 (Ed. Dr. F. Kemsies, Berlin; publisher, H. Walther, Berlin). Bimonthly. 8 M.

The *Archiv f. System. Philos.*, Bd. IX., Heft 4, contains its annual Bibliography of Philosophical Literature for 1897 of 2307 titles. The *Revue Néo-Scholastique* also continues its quarterly *Sommaire Idéologique*, printed on one side of the paper only, for pasting on cards.

At a recent meeting of the Academy of Moral and Political Sciences, the Gegner prize (3,800 fr.) was awarded to M. F. Pillon, the Jean Reynaud prize (10,000 fr.) to M. Paul Janet, and half of the Penanrun prize (2,000 fr.) to l'Abbé Piat for his book *La Personne humaine*.

The attention of psychologists may be called to a 'Critical Review' on 'Modern Neurology' by Dr. Adolf Meyer, beginning in the *Journ. of Comp. Neurology*, November, 1898.